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THE

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STRAITS SETTLEMENTS

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1935.

H. N. Ridley, C. M. G., F. R. S.

THE

GARDENS' BULLETIN

STRAITS SETTLEMENTS

Vol. IX 20th December, 1935. Part 1

This Bulletin is dedicated to

HENRY NICHOLAS RIDLEY, C.M.G., M.A., F.R.S.

Director of Gardens, Straits Settlements, 1888–1911

on the occasion of his 80th birthday

Mr. Ridley's work as a field botanist added more than that of any other single man to our knowledge of the flora of the Malay Peninsula; his *Flora* is the foundation upon which all future work must rest; he actively pursued the experimental cultivation of agricultural plants at a time when agricultural interests in Malaya were at a low ebb; in particular, his persistent advocacy of the plantation of Para Rubber and his pioneer tapping experiments were largely responsible for the foundation of that industry upon which so large a share of the wealth of Malaya has rested; his reports on timbers, rattans, and other forest products of the Peninsula were the first adequate works of their kind and embodied much original information; he added very considerably to the collection of cultivated plants, both Malayan and exotic, in the Botanic Gardens, Singapore; his wide interests, not only in botany but also in entomology, geology and other branches of natural science, found expression in a series of papers which are enumerated in the bibliography which follows. Few men have accomplished so much in 23 years of tropical service, and few have been able to complete their work after retirement as Mr. Ridley has completed it.

The contributors to this Bulletin, and many more who have followed in the paths where Mr. Ridley led, unite in congratulating him on the present happy occasion.

BIBLIOGRAPHY OF THE WORKS OF MR. H. N. RIDLEY, FROM 1872 TO 1935,

compiled by

M. R. HENDERSON and C. G. G. J. VAN STEENIS

This bibliography has been made as complete as possible, but as Mr. Ridley has published, over a long period, a very large amount of material covering a very wide field of pure and applied botany, the compilers realise that a number of papers may have been overlooked.

During 63 years of activity Mr. Ridley has published, according to this bibliography, more than 500 books, papers and notes, amounting to nearly 10,000 printed pages.

Amongst the more important works may be mentioned his various papers on Monocotyledons, on which he was a well known authority; and his various articles on plant dispersal, resulting in his monumental "Dispersal of Plants throughout the World", published when he was 75, an age at which most authors are content to enjoy a well earned rest. His life-work, however, has been devoted to Malaysian botany, to the knowledge of which he has contributed largely, both as a writer and as a keen collector.

1872

Mammals and Coleoptera of Haileybury (School Nat. Hist. Report, 1872).

1875

Sphinx convolvuli at Cobham, Kent (Entomologist, 1875, p. 223).

1876

Hibernation of Hemerobius (Entomologist, 1876, p. 48).

1878

Coleoptera hunting in 1877 (Entomologist, 1878, p. 22).

Acronycta Alni in Hereford (Entomologist, 1878, p. 230).

1879

Doridicola antheæ, n. sp. (Copepoda) (Ann. Mag. Nat. Hist. 4, 1879, p. 458).

1880

Spring flowering form of Colchicum autumnale (Journ. Bot. 18, 1880, p. 185).

Observations on some Larvæ of Chrysopa (Entomologist, 13, 1880, p. 21).

Some English Collembola (Entomologists' Monthly Magazine, 17, 1880, p. 1).

1881

A new variety of Carex pilulifera L. (Journ. Bot. 19. 1881, p. 97–98, 152, t. 218).

Notes on Radnorshire plants (Journ. Bot. 19, 1881, p. 170–174).

Degeeria Eatoni, n. sp. (Entomologists' Monthly Magazine, 17, 1881, p. 270).

Thysanura of Canary Isles (Entomologists' Monthly Magazine, 18, 1881, p. 14).

1882

(With FAWCETT) Additions to the flora of Dorset (Journ. Bot. 20, 1882, p. 246).

1883

Teratological notes on plants I. (Journ. Linn. Soc. London, Bot. 20, 1883, p. 45–48, 3 figs., read 1882).

Descriptions and notes on new or rare monocotyledonous plants from Madagascar, with one from Angola (Journ. Linn. Soc. London, Bot. 20, 1883, p. 329–338).

On the generic names Dantia and Prouvenzalia (Journ. Bot. 21, 1883, p. 349).

1884

The Cyperaceae of the West Coast of Africa in the Welwitsch Herbarium (Transact. Linn. Soc. London, Bot. 2nd ser., vol. 2, 1884, p. 121–172, pl. 22–23).

Cyperaceæ novæ (Journ. Bot. 22, 1884, p. 15–17).

Kerry plants (Journ. Bot. 22, 1884, p. 91–92).

Shetland plants (Journ. Bot. 22, 1884, p. 301).

Bees and Erica cinerea (Journ. Bot. 22, 1884, p. 302).

A new Bornean Orchid (Journ. Bot. 22, 1884, p. 333).

On Didymoplexis sylvatica (Leucorchis sylvatica Blume) (Journ. Bot. 22, 1884, p. 345–346).

A new species of Albuca from Aden (Journ. Bot. 22, 1884, p. 370).

Additions to "Topographical Botany" (Journ. Bot. 22, 1884, p. 377–378).

1885

The Orchids of Madagascar (Journ. Linn. Soc. London, Bot. 21, 1885, p. 456–522, pl. 15).

Prodromus floræ timorensis; compiled by the Botanical Department of the British Museum, Monocotyledones (in H. O. FORBES, A Naturalist's Wanderings, etc. 1885, p. 518–523).

On Juncus tenuis as a British plant (Journ. Bot. 23, 1885, p. 1–3, t. 253).

A new Carex from Sumatra (Journ. Bot. 23, 1885, p. 35–36).

A new Dendrobium from Siam (Journ. Bot. 23, 1885, p. 123).

A new Habenaria from Brazil (Journ. Bot. 23, 1885, p. 170).

Crocus Korolokawi in Afghanistan (Journ. Bot. 23, 1885, p. 185).

Peloria in Habenaria bifolia Br. (Journ Bot. 23, 1885, p. 218–219).

Castanea sativa Mill. as a native of Britain (Journ. Bot. 23, 1885, p. 253–254).

Two new British plants (Journ. Bot. 23, 1885, p. 289–291, t. 261–262).

On a new species of Gussonea (Journ. Bot. 23, 1885, p. 310).

Notes on British Rubi (Journ. Bot. 23, 1885, p. 370).

Angroecum glomeratum, n. sp. (Gardeners Chronicle, 24, 1885, p. 678).

1886

On the Monocotyledonous plants of New Guinea, collected by H. O. Forbes (Journ. Bot. 24, 1886, p. 321–327, 353–360, t. 270–271).

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On Dr. Fox's collection of orchids from Madagascar, along with some obtained by the Rev. R. Baron, F.L.S. from the same island (Journ. Linn Soc. London, Bot. 22, 1886, p. 116–127).

On the freshwater Hydrocharideæ of Africa and its islands (Journ. Linn. Soc. London, Bot. 22, 1886, p. 232–241, pl. 13–14).

Habenaria albida in Brecon (Journ. Bot. 24, 1886, p. 285).

A new Amorphophallus from Gambia (Journ. Bot. 24, 1886, p. 305–306).

Animal Life in High Latitudes (with S. O. Ridley) (Zoologist, 1886).

1887

On a new genus of Orchideæ from the island of St. Thomas, West Africa (Journ. Linn. Soc. London, Bot. 24, 1887, p. 197–200, pl. 6).

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Angolan Scitamineæ (Journ. Bot. 25, 1887, p. 129–135).

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An unknown island (Globe, Nov. 1887).

1888

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Proliferous Orchids (Gardeners Chronicle, 4, 1888, p. 676).

A visit to Fernando Noronha (Zoologist, 12, 1888, p. 41–49).

1889

On the foliar organs of a new species of Utricularia from St. Thomas, West Africa (Ann. Bot. 2, 1889, p. 305–307, pl. 19).

Report on the destruction of coconut palms by beetles (Journ. Str. Br. Roy. As. Soc. 20, 1889, p. 1–11).

1890

Notes on the Botany of Fernando de Noronha (Journ. Linn. Soc. London, Bot. 26, 1890, p. 1–74, pl. 1–4)

New Malayan plants (Journ. Bot. 1890, p. 99).

On the method of fertilisation in Bulbophyllum macranthum and allied Orchids (Ann. Bot. 4, 1890, p. 327–356, pl. 22A).

On the habits of the Caringa (Formica gracilipes Gray) (Journ. Str. Br. Roy. As. Soc. 22, 1890, p. 345–347).

Mosquito larvæ in the pitchers of Nepenthes (Journ. Str. Br. Roy. As. Soc. 22, 1890, p. 430).

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1891

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1892

Gambir (Agric. Bull. Mal. Peninsula no. 2 1892, p. 20–41).

1893

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Ngai Camphor (Agric. Bull. Mal. Peninsula no. 3, 1893, p. 55–56).

Fibres (Agric. Bull. Mal. Peninsula no. 3, 1893, p. 56–60).

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1894

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List of mammals recorded from Pahang (Journ. Str. Br. Roy. As. Soc. 25, 1894, p. 57–60).

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1895

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Two new species of Thismia (Ann. Bot. 9, 1895, p. 323–326, pl. 12).

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1896

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The Orchideæ and Apostasiaceæ of the Malay Peninsula (Journ. Linn. Soc. Bot. 32, 1896, p. 213–416).

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1897

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1898

Birds in the Botanic Gardens Singapore (Journ. Str. Br. Roy. As. Soc. 31, 1898, p. 73–89).

The Peliosanthes of the Malay Peninsula (Journ. Str. Br. Roy. As. Soc. 31, 1898, p. 91–98).

The white snake of the Selangor caves (Journ. Str. Br. Roy. As. Soc. 31, 1898, p. 99–101).

Note on precocious coconuts (Journ. Str. Br. Roy. As. Soc. 31, 1898, p. 103–104).

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The Poisonous plants of the Malay Peninsula (Agric. Bull. Mal. Peninsula no. 8, 1898, p. 199–220).

Shade Trees (Agric. Bull. Mal. Peninsula no. 8, 1898, p. 222–230).

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1899

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An insectivorous squirrel (Journ. Str. Br. Roy. As. Soc 32, 1899, p. 217).

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1900

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The Orang Laut of Singapore (Journ. Str. Br. Roy. As. Soc. 33, 1900, p. 247–250) (with W.W. Skeat).

Tiger's Milk, further note (Journ. Str. Br. Roy. As. Soc. 34, 1900, p. 101).

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A botanical excursion to Gunong Jerai (Kedah Peak) (Journ. Str. Br. Roy. As. Soc. 34, 1900, p. 23–30).

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1901

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Historical notes on the Rubber industry (Agric. Bull. S.S. & F.M.S. 9, no. 6, 1910, p. 201–213).

Coco-nuts in peat soil (Agric. Bull. S.S. & F.M.S. 9, no. 6, 1910, p. 214).

Another Para rubber fungus (Agric. Bull. S.S. & F.M.S. 9, no. 6, 1910, p. 216–218).

Report on the Expenimental tapping of Para rubber trees in the Botanic Gardens, Singapore for 1909 (with R. Derry) (Agric. Bull. S.S. & F.M.S. 9, nos. 7 & 8, 1910, p. 255–237, 289–297).

Further notes on Malay Camphor (Agric. Bull. S.S. & F.M.S. 9, no. 8, 1910, p. 299–300).

A. D. Machado and J. B. Carruthers, obituaries (Agric. Bull. S.S. & F.M.S. 9, no. 8, 1910, p. 328–329).

Rubber Fungi, a lecture delivered at the Agri-Horticultural Show (Agric. Bull. S.S. & F.M.S. 9, no. 9, 1910, p. 380–384).

Chilis as a catch-crop (Agric. Bull. S.S. & F.M.S. 9, no. 11, 1910, p. 450–452).

Disinfection of Rubber seeds (Agric. Bull. S.S. & F.M.S. 9, no. 11, 1910, p. 453–456).

Coco-nut trees attacked by a Coccid (Agric. Bull. S.S. & F.M.S. 9, no. 11, 1910, p. 465).

Planting of trees (Agric. Bull. S.S. & F.M.S. 9, no. 12, 1910, p. 481).

Dr. Melchior Treub, Dr. Burck, obituaries (Agric. Bull. S.S. & F.M.S. 9, no. 12, 1910, p. 495–496).

The Story of the Rubber industry (Malay States Development Agency, undated, probably 1910).

Butomaceæ, Hydrocharitaceæ, Gramineæ, Cyperaceæ, Flagellariaceæ, Pontederiaceæ, Liliaceæ, Ameryllidaceæ, Dioscoreaceæ, Zingiberaceæ and Marantaceæ in WINKLER, Beitr. z. Kenntnis der Flora und Pflanzengeographie Borneos (Engl. Bot. Jahrb. 44, 1910, p.518–532).

A termite's nest with 8 queens (Journ. Str. Br. Roy. As. Soc. 54, 1910, p. 157).

The abolition of the Botanic Gardens, Penang (Agric. Bull. S.S. & F.M.S. 9, 1910, p. 100–105; reprinted in Kew Bull. 1910, p. 153–158).

The Flora of the North-western States, Malay Peninsula (Kew Bull. 1910, p. 202–204).

Monocotyledonæ (with Hub. Winkler) (in Winkler, Beiträge zur Flora und Pflanzengeographie Südostborneos, Engl. Bot. Jahrb. 44, 1910, p. 518–532).

New or rare Malayan plants, series V. Journ. Str. Br. Roy. As. Soc. 54, 1910, p. 1–61).

Aristolochia minutiflora Ridley ms. (Kew Bull. 1910, p. 79).

Poisonous principles of Rhus (Pharmaceutical Journal, March 19, 1910, p. 360).

1911

Legislation against the dissemination of Pests (Agric. Bull. S.S. & F.M.S. 10, no. 1, 1911, p. 1–4).

Eutypa as a Parasite (Agric. Bull. S.S. & F.M.S. 10, no. 1, 1911, p. 6).

Gum Benjamin (Agric. Bull. S.S. & F.M.S. 10, no. 1, 1911, p. 12–16).

Rubber Smoking House (Agric. Bull. S.S. & F.M.S. 10, no. 3, 1911, p. 64–66).

Science and Agriculture (Agric. Bull. S.S. & F.M.S. 10, no. 3, 1911, p. 66–68).

Hevea disease in Ceylon (Agric. Bull. S.S. & F.M.S. 10, no. 3, 1911, p. 70–71).

Mustard as a Catchcrop for Rubber (Agric. Bull. S.S. & F.M.S. 10, no. 3, 1911, p. 74).

Spangle-scale on Soursop (Agric. Bull. S.S. & F.M.S. 10, no. 3, 1911, p. 74–75).

Chonemorpha rubber vines (orig. descript. of Ch. Rheedei and Ch. penangensis) (Agric. Bull. S.S. & F.M.S. 10, no. 5, 1911, p. 146–148).

Fasciation in Eucharis (Agric. Bull. S.S. & F.M.S.. 10, no. 5, 1911, p. 154).

The Drought spell (Agric. Bull. S.S. & F.M.S. 10, no. 6, 1911, p. 181–186).

Travelling of Rubber seed (Agric. Bull. S.S. & F.M.S. 10, no. 6, 1911, p. 191–192).

Stumping on Estates (Agric. Bull. S.S. & F.M.S. 10, no. 6, 1911, p. 195).

Birds and Crops (Agric. Bull. S.S. & F.M.S. 10, no. 8, 1911, p. 232–235).

Cinnamomum Deschampsii (Agric. Bull. S.S. & F.M.S. 10, no. 8, 1911, p. 235).

Abnormal Rubber tree (Agric. Bull. S.S. & F.M.S. 10, no. 11, 1911, 351–352).

Root-shoots in Casuarina glauca (Agric. Bull. S.S. & F.M.S. 10, no. 11, 1911, p. 359).

A Bleeding Rubber tree (Agric. Bull. S.S. & F.M.S. 10, no. 11, 1911, p. 361).

The Flora of Lower Siam (Journ. Str. Br. Roy. As. Soc. 59, 1911, p. 15–26).

The Gymnosperms of the Malay Peninsula (Journ. Str. Br. Roy. As. Soc. 60, 1911, p. 53–68).

An Account of a Botanical Excursion to Lower Siam (Journ. Str. Br. Roy. As. Soc. 59, 1911, p. 27–234, map.).

The Rt. Rev. M. F. Hose, D.D. (Journ. Str. Br. Roy. As. Soc. 57, 1911, p. 3–4).

A scientific expedition to Temengoh, Upper Perak (Journ. Str. Br. Roy. As. Soc. 57, 1911, p. 5–122).

Rengas Poisoning (Malayan Medical Journal, 9, 1911, p. 7–13).

A retrospect and some cautions (Grenier's Rubber News, Kuala Lumpur, 1911).

1912

A botanical excursion to Pulau Adang (Journ. Str. Br. Roy. As. Soc. 61, 1912, 45–65).

New plants from Sarawak (Sarawak Mus. Journ. 12, 1912, p. 30–38).

Spices (1912, Macmillan & Co., London, viii + 449 pp.).

New or rare Malayan plants (series VI) (Journ. Str. Br. Roy. As. Soc. 61, 1912, p. 1–43).

Some plants collected on Moulton's Expedition to Batu Lawi (Journ. Str. Br. Roy. As. Soc. 63, 1912, p. 59–62).

Decades Kewenses (Kew Bull. 1912, p. 380–389).

1913

Contributions to a flora of Borneo (Sarawak Mus. Journ. 13, 1913, p. 67–98).

Some Bornean Aroideæ (Journ. Bot. 51, 1913, p. 201–202, t. 527).

An expedition to Mount Mĕnuang Gasing, Selangor; with an account of the journey by C. B. Kloss (Journ. Linn. Soc. Bot. 41, 1913, p. 285–304).

A new Alpinia from Borneo (Journ. Bot. 51, 1913, p. 247).

Decades Kewenses (Kew Bull. 1913, p. 267–268).

African Zingiberaceæ (in Talbot's South Nigerian Plants, Brit. Mus. Public., 1913, p. 110–112).

1914

On a collection of plants from G. Mengkuang Lebah, Selangor (Journ. Fed. Mal. St. Mus. 5, 1914, p. 28–50).

Plantæ novæ papuanæ (Journ. Bot. 52, 1914, p. 289–296).

Decades Kewenses (Kew Bull. 1914, p. 188, 209–210, 211, 324, 327, 332, 377–378).

Moraceæ, Scitamineæ, Hæmodoraceæ, Iridaceæ, Amaryllidaceæ, Taccaceæ, Dioscoreaceæ, Liliaceæ, Pontederiaceæ, Xyridaceæ, Commelinaceæ, Araceæ, Eriocaulaceæ, in L. S. Gibbs Contribution Flora, etc. of Mt. Kinabalu (Journ. Linn. Soc. London Bot. 42, 1914, p. 136–138, 162–167, 171–172).

Cypripedium Pereiræ, n. sp. (Gardeners Chronicle, 55, 1914, p. 236).

1915

On two new plants from Gunong Tampin, Negri Sembilan (Journ. Fed. Mal. Stat. Mus. 6, pt. 1, 1915, p. 39).

A new Begonia from Borneo (Sarawak Mus. Journ. 26, 1915, p. 177).

An expedition to Mt. Menuang Gasing, Selangor (Journ. Fed. Mal. Stat. Mus. 6, 1915, p. 1–21).

Plants from G. Kerbau, Perak (Journ. Fed. Mal. Stat. Mus. 6, 1915, p. 43–62).

New or rare Malayan plants series VII (Journ. Str. Br. Roy. As. Soc. 68, 1915, p. 11–14).

Two new orchids from the Prov. of Bandon, S.W. Siam (Journ. Fed. Mal. Stat. Mus. 5, 1915, p. 156–157).

The plants of Koh Samui and Koh Pennan (Journ. Fed. Mal. Stat. Mus. 5, 1915, p. 158–168).

The botany of G. Tahan (Journ. Fed. Mal Stat. Mus. 6, 1915, p. 127–202).

Cytinaceæ and Balanophoraceæ in Gamble, Materials for a flora of the Malay Peninsula (Journ. As. Soc. Bengal 75, pt. 4, 1915, p. 393–399).

1916

Drimys elongata Ridl. (Hooker, Icon. Plant. 31, 1916, t. 3051).

Aglaia rubra Ridl. (Hook. Icon. Plant. 31, 1916, t. 3052).

Timonius vaccinioides Wernh. (Hook. Icon. Plant. 31, 1916, t. 3054).

Vittadinia disticha S. Moore (Hook. Icon. Plant. 31, 1916, t. 3055).

Mischopleura Ridleyana Wernh. and M. ovalifolia Wernh. (Hook. Icon. Plant. 31, 1916, t. 3059).

Neowollastonia tabernæmontanoides Wernh. (Hook. Icon. Plant. 31, 1916, t. 3060).

Solanum peranomalum Wernh. (Hook Icon. Plant . 31, 1916, t. 3062).

Eriolopha flagellaris Ridl. (Hook. Icon. Plant. 31, 1916, t. 3067).

New or rare Malayan plants series VIII (Journ. Str. Br. Roy. As. Soc. 73, 1916, p. 139–146).

On endemism and the mutation theory (Ann. Bot. 30, 1916, p. 551–574).

Report on the Botany of the Wollaston Expedition to Dutch New Guinea 1912–1913 (Trans.Linn. Soc. London Bot. ser. 2, 9, 1916, p. 1–269).

The natural history of Kedah Peak V. Botany (Journ. Fed. Mal. Stat. Mus. 7, 1916, p. 37–58).

The large Mias in the Zoological Gardens (Field, July, 1916).

Cultivation of Rubber in Malaya and Burma (Times Supplement, 1916).

1917

New or rare Malayan plants series IX (Journ. Str. Br. Roy As. Soc. 75, 1917, p. 5–38).

The scientific exploration of the Malay Peninsula (Journ. Str. Br. Roy. As. Soc. 75, 1917, p. VII–XI).

Botany of Kedah Peak (Journ. Fed Mal. Stat. Mus. 7, 1917, p. 12).

Lasianthus barbellatus, a new species from P. Tiuman (Journ. Str. Br. Roy. As. Soc. 77, 1917, p. 187, 1 fig.).

Results of an expedition to Korinchi Peak, Sumatra (Journ. Fed. Mal. Stat. Mus. 8, part 4, 1917, p. 9–145).

Moraceæ in L. S. Gibbs, Contribution to the Flora and Phytography of the Arfak Mts., etc. 1917, p. 208–209.

1918

New or rare Malayan plants series X (Journ. Str. Br. Roy. As. Soc. 79, 1918, p. 63–100).

Hoseanthus Merr. nov. gen. (Journ. Str. Br. Roy. As. Soc. 79, 1918, p. 17).

Appendix II to Gibbs, Some peculiar Papuan customs (Journ. Str. Br. Roy. As. Soc. 79, 1918, p. 16).

1919

The fern-allies and Characeæ of the Malay Peninsula (Journ. Str. Br. Roy. As. Soc. 80, 1919, p. 139–164).

Cultivated Arundinas (Orchid Review, 27, 1919, p. 46).

1920

New Malayan plants (Journ. Bot. 58, 1920, p. 147–149, 195–196).

New or rare plants from the Malay Peninsula (Journ. Fed. Mal. Stat. Mus. 102, 1920, p. 128–156).

New or rare species of Malayan plants (Journ. Str. Br. Roy. As. Soc. 82, 1920, p. 167–204).

On a collection of plants from Peninsula Siam (Journ. Fed. Mal. Stat. Mus. 10, 1920, p. 65–126).

Two new Siamese plants (Journ. Fed. Mal. Stat. Mus. 10, 1920, p. 127).

Plantago Cynops L. in Kent (Journ. Bot. 58, 1920, p. 127–272).

1921

The Indo-Malayan species of Jussieua (Journ. Bot. 59, 1921, p. 257–260).

Plant dermatitis (Journ. Bot. 1921, p. 310).

Plants from Annam, Scitamineæ and Orchideæ (Journ. Nat. Hist. Siam, 4, 1921, p. 109).

1922

The Flora of the Malay Peninsula, Vol. I (Reeve & Co., London, 1922, p. xxxv+918).

Rigiolepis and other Vacciniaceæ of Borneo (Kew Bull. 1922, p. 106–108).

The Flora of Klang Gates, Selangor (Journ. Fed. Mal. Stat. Mus. 10, 1922, p. 247–251).

New or rare Malayan plants series XII (Journ. Str. Br. Roy. As. Soc. 86, 1922, p. 292–311).

Sandoricum Koetjape and Dendrobium caninum (Journ. Bot. 60, 1922, p. 273–274).

Plant Dermatitis (Journ. Trop. Med. & Hyg. 25, no. 14, 1922, p. 225–227).

Musaceæ, Zingiberaceæ and Marantaceæ in C. T. WHITE, A contribution to our knowledge of the Flora of Papua (British New Guinea) (Proc. Roy. Soc. Queensl. XXXIV, no. 1, 1922, p. 19–22).

Note on clearing ponds with Copper Sulphate (Field, May, 1922).

1923

New Euphorbiaceæ from the Malay Peninsula (Kew Bull. 1923, p. 360–369).

The Flora of the Malay Peninsula Vol. 2 (Reeve & Co., London, 1923 p. vi+672, fig. 76–131).

A Botanical Excursion in Northern Sumatra (Journ. Mal. Br. Roy. As. Soc. 87, 1923, p. 46–113).

The distribution of plants (Ann. Bot. 37. 37, 1923, p. 1–29).

Koetjape and sentol (Journ. Bot. 61, 1923, p. 200–201).

Vanda punctata Ridley (Kew Bull. 1923, p. 118).

1924

The Flora of the Malay Peninsula vol. 3 (Reeve & Co., London, 1924, p. vi+406, fig. 1–159).

New Malayan plants (Journ. Bot. 62, 1924, p. 294–301).

The Flora of the Malay Peninsula, Vol. 4 (Reeve & Co., London, 383 pp., fig. 169–209).

Lotus siliquosus L. in Berks (Journ. Bot. 62, 1924, p. 246).

Decades Kewenses (Kew Bull. 1924, p. 202, 204, 261–262, 263, 266).

Poisoning by Bamboo Hairs (Journ. Trop. Med. & Hyg. 27, 1924, p. 278).

Evodia quercifolia, n. sp. (Gardeners Chronicle, 76, 1924, p. 303).

1925

The Flora of the Malay Peninsula vol. 5 (Reeve & Co., London, 470 pp., fig. 210–229).

Plants of Bencoolen collected by Mr. C. J. Brooks (Kew Bull. 1925, p. 76–94).

New Diospyros from Sarawak (Journ. Bot. 63, 1925, p. 51–52).

Endemic plants (Journ. Bot. 63, 1925, p. 182–183).

Dr. H. O. Forbes' Malayan plants. Monocotyledones (Journ. Bot. 63, 1925, Suppl. p. 115–127).

Globba Burbidgei Ridley n. sp. (Journ. Bot. 63, 1925, p. 204).

Decades Kewenses (Kew Bull. 1925, p. 280–281).

Use of Iodine in Beri-beri (Journ. Trop. Med. & Hyg. 28, 1925, p. 102–103).

1926

Spolia Mentawiensia (Kew Bull. 1926, p. 57–94).

The ferns of the Malay Peninsula (Journ. Mal. Br. Roy. As. Soc. 4, 1926, p. 1–121).

Additions to the flora of Malaya (Kew Bull. 1926, p. 469–479).

Cause of hairlessness in Man (Journ. Trop. Hygiene, Sept. 15, 1926, p. 303).

White Blackbird in Kew Gardens (Country Life, Jan. 1926).

Habits of Pangolin (Country Life, Jan. 1926).

1927

The genus Argostemma (Journ. Bot. 65, 1927, p. 25–41).

A correction.—Sonerila ciliata (Journ. Bot. 65, 1927, p. 184).

Rev. W. A. Taylor, M.A. Obituary (Journ. Bot. 65, 1927, p. 317).

Voices of Apes (London Illustrated News, Sept. 17, 1927).

Letter on Rubber Industry (Journal of Heredity, 9, 1927, p. 485).

1928

Cotyledon Umbilicus as an epiphyte (Journ. Bot. 66, 1928, p. 273).

Charles Curtis. Obituary (Journ. Bot. 66, 1928, p. 332–333).

Decades Kewenses (Kew Bull. 1928, p. 72–78).

History of the evolution of the cultivated Rubber industry (Bull. Rubber Growers' Ass. 1928, p. 3–7).

1929

New species from the Malay Peninsula and Borneo (Kew Bull. 1929, p.254–262).

Schefflera minimiflora Ridl. comb. nov. (Journ. Bot. 67, 1929, p. 87).

H. C. Robinson. Obituary (Journ. Bot. 67, 1929, p. 261).

Elephant Cemeteries (Times, London, August 5, 1929).

1930

Additions to the flora of Borneo and other Malay Islands (Kew Bull. 1929, p. 364–373).

The Dispersal of Plants throughout the World. (Reeve & Co., Kent, 1930, xx+744 pp., 22 pl).

Myrtaceæ malayenses (Journ. Bot. 68, 1930, p. 10–17, 33–39).

Asiatic species of Pleomele (Journ. Bot. 68, 1930, p. 177–181).

Additions to the flora of Borneo (Kew Bull. 1930, p. 74–87).

On the action of the poison of the Upas tree (*Antiaris toxicaria* Bl.) (Journ. Trop. Med. & Hyg. July, 1930, p.1–2).

1931

Additions to the flora of Borneo and other Malay Islands II (Kew Bull. 1931, p. 33–39).

Additions to the flora of Borneo and other Malay Islands III (Kew Bull. 1931, p. 493–499).

Decades Kewenses LX (Kew Bull. 1931, p. 448–449).

How Plants move about (The Listener, May 20, 1931).

1932

Taraktogenos calophylla Ridley (Hook. Icon. Plant. 32, 1932, t. 3167).

Sonerila Ruttneri n. sp., Didissandra parviflora n. sp. (Arch. f. Hydrobiol. Suppl. Bd. 11, 1932, p. 312–313, 327–328).

The genus Urophyllum in Malaya (Journ. Bot. 70. 70, 1932, p. 191–197, 219–226).

Sir Everard Ferdinand im Thurm. Obituary (Journ. Bot. 70, 1932, p. 341–342).

Poisonous Nature of *Derris elliptica* (Pharmaceutical Journal, 129, 1932, p. 387).

1933

G. Ramage. Obituary (Journ. Bot. 71, 1933, p. 75).

Rocks grooved by Ficus roots (Journ. Bot. 71, 1933, p. 75–76).

Additions to the flora of Borneo and other Malay Islands IV (Kew Bull. 1933, p. 190–202).

Contributions towards a flora of British North Borneo III (Kew Bull. 1933, p. 487–495).

Fruiting of Passion-flower (*Passiflora*) in England (Times, London, March 10, 1933).

1934

Firmiana and Erythropsis (Kew Bull. 1934, p. 214–217).

Some dispersal notes (Journ. Bot. 72, 1934, p. 52–53).

J. D. Gimlette. Obituary (Journ. Bot. 72, 1934, p. 176).

New Malayan Rubiaceæ (Journ. Bot. 72, 1934, p. 251–257, 271–275).

Dorycnium gracile in Kent (Journ. Bot. 72, 1934, p. 349–350).

Review of Beccari's Asiatic Palms, Corypheæ (Nature, 133, 1934, p. 122).

Notes on insects special protection (Proc. Roy. Soc. London, 7, 1934, p. 634).

1935

Malay violets (Journ. Bot. 73, 1935, p. 13–18).

LIST OF PLANTS NAMED IN HONOUR OF MR. H. N. RIDLEY.

GENERA.

RIDLEYELLA, Schlechter (Orchidaceae).

RIDLEYINDA, Kuntze (Dipterocarpaceae).

SPECIES.

Malay Peninsula:—

Acriopsis Ridleyi, Hook. f. (Orchidaceae).
Acroceras Ridleyi, Stapf (Gramineae).
Actinodaphne Ridleyi, Gamble (Lauraceae).
Actoplanes Ridleyi, Schum. (Zingiberaceae).
Alangium Ridleyi King (Cornaceae).
Alseodaphne Ridleyi, Gamble (Lauraceae).
Amoora Ridleyi, King (Meliaceae).
Ardisia Ridleyi, King & Gamble (Myrsinaceae).
Argostemma Ridleyi, King (Rubiaceae).
Bauhinia Ridleyi Prain (Leguminosae).
Bambusa Ridleyi, Gamble (Gramineae).
Calamus Ridleyanus, Beccari (Palmae).
Castanopsis Ridleyi, Gamble (Cupuliferae).
Cephaelis Ridleyi, King & Gamble (Rubiaceae).
Cinnamomum Ridleyi, Gamble (Lauraceae).
Clerodendron Ridleyi, King & Gamble (Verbenaceae).
Diospyros Ridleyi, Bakh. (Ebenaceae).
Embelia Ridleyi, King & Gamble (Myrsinaceae).
Endopogon Ridleyi, Clarke (Acanthaceae).
Epigynum Ridleyi, King & Gamble (Apocynaceae).
Eria Ridleyi, Rolfe (Orchidaceae).
Eugenia Ridleyi, King (Myrtaceae).
Eulalia Ridleyi, Stapf (Gramineae).
Fagraea Ridleyi, King & Gamble (Loganiaceae).
Filetia Ridleyi, Clarke (Acanthaceae).
Galearia Ridleyi, Gage (Euphorbiaceae).
Genianthus Ridleyi, King & Gamble (Asclepiadaceae).
Goniothalamus Ridleyi, King (Anonaceae).
Gnetum Ridleyi, Gamble (Gnetaceae).
Gymnostachyum Ridleyi, Clarke (Acanthaceae).
Hemigraphis Ridleyi, Clarke (Acanthaceae).
Henslowia Ridleyi, Gamble (Santalaceae).
Homalomena Ridleyana, Engl. (Araceae).
Horsfieldia Ridleyana, Warb. (Myristicaceae).
Hoya Ridleyi, King & Gamble (Asclepiadaceae).
Impatiens Ridleyi, Hook. f. (Balsaminaceae).
Kopsia Ridleyana, King & Gamble (Apocynaceae).
Kunstleria Ridleyi, Prain (Leguminosae).
Lasianthus Ridleyi, King & Gamble (Rubiaceae).
Lecanorchis Ridleyana, Schl. (Orchidaceae).
Lettsomia Ridleyi, Prain (Convolvulaceae).
Litsea Ridleyi, Gamble (Lauraceae).
Lucinaea Ridleyi, King & Gamble (Rubiaceae).
Meliosma Ridleyi, King (Sabiaceae).
Morinda Ridleyi, King & Gamble (Rubiaceae).

Ochlandra Ridleyi, Gamble (Gramineae).
Oryza Ridleyi, Hook. f. (Gramineae).
Pachynocarpus Ridleyanus, Brandis (Dipterocarpaceae).
Palaquium Ridleyi, King & Gamble (Sapotaceae).
Pandanus Ridleyi, Martelli (Pandanaceae).
Pentaphragma Ridleyi, King & Gamble (Campanulaceae).
Piper Ridleyi, C. DC. (Piperaceae).
Piptospatha Ridleyi, Hook. f. (Araceae).
Polyosma Ridleyi, King (Saxifragaceae).
Premna Ridleyi, King & Gamble (Verbenaceae).
Psychotria Ridleyi, King & Gamble (Rubiaceae).
Saprosma Ridleyi, King & Gamble (Rubiaceae).
Schefflera Ridleyi, Viguier (Araliaceae).
Schismatoglottis Ridleyana, Engl. (Araceae).
Scleria Ridleyi, Clarke (Cyperaceae).
Scleropyrum Ridleyi, Gamble (Santalaceae).
Sclerostachyum Ridleyi, Stapf (Gramineae).
Shorea Ridleyana, King (Dipterocarpaceae).
Spatholobus Ridleyi, Prain (Leguminosae).
Stenothyrsus Ridleyi, Clarke (Acanthaceae).
Strychnos Ridleyi, King & Gamble (Loganiaceae).
Styrax Ridleyanum, Perkins (Styraceae).
Symplocos Ridleyi, King & Gamble (Symplocaceae).
Tarenna Ridleyi, Pearson (Rubiaceae).
Tylophora Ridleyi, Henders. (Asclepiadaceae).
Uvaria Ridleyi, King (Anonaceae).
Wikstoemia Ridleyi, Gamble (Thymeleaceae).
Xylopia Ridleyi, King (Anonaceae).
Xyris Ridleyi, Rendle (Xyridaceae).

Ferns:—

Alsophila Ridleyi, Baker.
Athyrium Ridleyi, Copeland.
Lastrea Ridleyi, Beddome.
Microlepia Ridleyi, Copeland.
Platycerium Ridleyi, Christ.
Trichomanes Ridleyi, Copeland.

Borneo:—

Coelogyne Ridleyana, Schltr. (Orchidaceae).
Dendrobium Ridleyi, Merr. (Orchidaceae).
Dioscorea Ridleyi, Prain & Burkill (Dioscoreaceae).
Panicum Ridleyi, Hack. (Gramineae).
Pollinia Ridleyi, Hack. (Gramineae).
Raphidophora Ridleyi, Merr. (Araceae).
Sarcanthus Ridleyi, J. J. Smith (Orchidaceae).
Saurauia Ridleyi, Merr. (Ternstroemiaceae).
Thoracostachyum Ridleyi, Clarke (Gramineae).

Siam:—

Dendrobium Ridleyanum, Kerr (Orchidaceae).
Hedyotis Ridleyana, Craib (Rubiaceae).
Ophiorrhiza Ridleyana, Craib (Rubiaceae).

Mr Ridley and his collector Achmad bin Hassan in the Gardens Jungle, about 1909.

MR. RIDLEY'S WORK FOR TROPICAL AGRICULTURE.

By F. W. South,
Chief Field Officer, Department of Agriculture S.S. & F.M.S.

Introduction.

Mr. H. N. Ridley, C.M.G., F.R.S., was Director of Gardens, Straits Settlements from 1888 to 1911 and for the period 1888 to 1894 was also Director of Forests, Straits Settlements. Probably but few people at the present time realise how great a debt Malaya as a whole owes to Ridley for his services in laying a sure foundation for that agricultural development which subsequently brought so much prosperity to this country.

The work which Ridley did during his period of service in Malaya was only rendered possible by his tireless energy and enthusiasm and his wide knowledge of biology, including both botany and zoology. He specialised more particularly in botany, including in that term pure botany as a sience and botany as applied to forestry and agriculture, but his knowledge of zoology enabled him to render further services to agriculturists by devising measures for the control of insect pests of various crops.

For about twelve years of his service Ridley with his staff of two or three European Officers serving as Superintendents or Assistant Superintendents of Gardens and Forests in Singapore, Malacca and Penang, represented the only organisation in the Colony or the Native States, as they were then known, to which agriculturists could apply for technical advice and assistance. The need for such assistance naturally increased steadily throughout this period, since it covers the early extension of large scale agriculture in the Malay States. When it is remembered that the whole period of his service corresponds closely with that of the growth of the rubber industry in this country from its earliest infancy to the great boom of 1910–1911, it becomes possible to realise how great were the calls made on Ridley and his staff. The demands from the agricultural community for planting material of Para rubber and for advice on every aspect of this new and quite unknown crop occupied in themselves a large share of the time of Ridley and his assistants.

In spite, however, of the demands of the growing rubber industry and the claims of the more purely scientific aspect of botany as represented by the maintenance of the Botanic Gardens in Singapore and the collection, identification and description of local plants, Ridley was able to carry out work on a range of plants which comprised most of the actual or potential tropical crops known.

Ridley's work on rubber is dealt with in a separate article in this number, so that the remarks which follow deal only with some of his work on other crops.

The Economic Garden.

In 1888 when Ridley assumed duty there was in Singapore under the Forest Department, an Experimental or Economic Garden near the Botanic Gardens, in which experiments were in progress with English vegetables and fruit trees of various kinds, together with trials of patchouli, coca (the plant from which cocaine is obtained) cubebs peper, ordinary black pepper, cacao, tapioca and various trees yielding rubber. In 1889 Ridley recommended that this Experimental Garden should be removed from the Forest Department and be placed under the Gardens vote. In making this suggestion he wrote :—

> "I hope to increase the area under cultivation this year and, wherever I can, to make the whole an Economic Garden worthy of the Colony".

In the following year this transfer was effected.

In the years which followed Ridley gradually increased the size of this Garden and added to the collection of economic plants which it contained, until in his Annual Report for 1906 he was able with full justice to write of it :—

> "This part of the Gardens has steadily increased in usefulness and importance, not only to the local community but to all the tropical parts of the Empire, and indeed it would be difficult to over estimate its utility. All tropical plants are experimented with and stocks of all for which there is or is likely to be an exceptional demand are maintained in considerable quantities. It may give some idea of the work carried out if it is mentioned that during the year plants or seeds have been despatched on sale to countries as remote as the West Indies, including Cuba, Samoa, Honolulu, Queensland, New South Wales, West Australia, Fiji Islands, Philippines, New Guinea, China, Hongkong, Borneo, Sumatra, Java, India, Ceylon, Egypt, Lagos, Nigeria and Madiera, while the local demand from the Colony and Federated Malay States has increased enormously".

Two of the objects of this Garden are clearly stated in the paragraph quoted, namely to experiment with all known tropical crops, or tropical plants likely to prove of economic value, more especially as regards their suitability for cultivation locally, and to provide planting material of those for which there was a demand. It also served a third purpose by providing demonstrations to visiting planters of the alternative or new crops in which they were interested.

In addition to the Economic Garden in Singapore there were in the earlier part of this period two other localities in the Colony where work on economic crops was conducted.

One of these was the Bukit Sebukor Experimental Garden in Malacca. This was under the Forest Department and was used partly as a nursery for forest trees and partly for experiments with agricultural crops such as Mauritius hemp, tobacco, castor oil, pepper, Maltese oranges and lemons, cloves, nutmegs, Liberian coffee, tea, cacao and Egyptian cotton. The cotton and cacao were not successful. Liberian coffee was considered to require manuring on poor soil. The tea, a Hybrid Assam type, did fairly well, as did the nutmegs and cloves on the better soil in this garden. In 1893, however, on the recommendation of the Retrenchment Committee of that year this garden was abandoned, partly because much of the soil on this site was very poor.

Another locality was the Hill Nursery and Government Bungalow Garden on Penang Hill. The Nursery was used for trials of fruit trees and it is mentioned in the Annual Report for 1888 that an apple tree from Australia bore 8 fruits of large size and fair flavour, but olives produced no fruit. In 1891 an avocado pear tree in this Nursery fruited for the first time and in 1894 three of the same trees bore a heavy crop. Lechee, loquat, olives and peaches do not appear to have produced fruit and oranges from Malta gave a few fruits, but of moderate flavour and not in economic quantities. The bungalow garden was used for raising vegetables of which, according to the Report for 1894, carrots, beet, leeks, lettuce, khol rabi, radish, peas and in the dry season tomatoes were the most successful. In 1898 potatoes gave a fair crop but several were diseased. The great handicap on the Hill was the expense of farmyard manure when the charges for transport, in the absence of a a road or railway, were added, while another expensive item was the construction of a terrace round each fruit tree to prevent soil erosion by heavy rains. Little work was done in this fruit nursery after 1897 and an attempt was made to reafforest the site with useful trees in 1900. The Bungalow Garden was, however, regularly upkept and continued to give a supply of vegetables.

The Waterfall Gardens in Penang provided little room for work on econmic crops, but well known tapping trials on one of the rubber trees in that Garden were commenced in 1898 by the Assistant Superintendent, Mr. Curtis, and were maintained for at least eleven years. Other economic activities at this garden were mainly confined to raising young plants for trial on estates in the island or in Province Wellesley. Thus in 1896 Mr. Curtis raised a fairly large number of Borneo sugar canes from seed and in the following two years distributed them for trial on estates. From 1895 to 1897 a stock of Ramie fibre plants was built up for distribution and some interesting observations on varieties of this plant were made. In 1903 and 1904,

Mr. Fox, then Superintendent, carried out experiments with Egyptian and Sea Island cottons. These experiments in conjunction with those carried out on estates in the Settlement led him to conclude that in the cultivation of cotton the Straits Settlements could not compete with other cotton growing countries.

In the Malay States, Sir Hugh Low planted Hevea rubber trees a few other economic trees behind the Residency at Kuala Kangsar in 1878 and following years, but there was no Experimental or Economic Garden of much size or importance until Mr. Arden, Superintendent of Experimental Plantations, Selangor, commenced the establishment of the Batu Tiga Plantation towards the end of 1902.

In these circumstances the Economic Garden in Singapore was the chief source of information on various crops and of planting material for the whole Peninsula, until such time as the Department of Agriculture, Federated Malay States, created in 1904, had developed sufficiently to take its share of this work.

Examination of the Annual Reports of the Botanic Gardens, Singapore, shows how wide a range of plants was tried and reveals several points of interest.

Throughout the period of Ridley's tenure of office there was a demand, varying somewhat from time to time, for planting material of most of the well known local crops, such as pepper, cloves, nutmegs, tapioca, gambier and local fruit trees. These call for little comment beyond the fact that six good varieties of tapioca from British Guiana were introduced in 1888.

Until the cultivation of Para rubber began to monopolise attention in the first decade of this century, a number of plants were tried in the Economic Garden with a view to ascertaining those which would be most suitable for use in large scale agricultural development in the Peninsula. Beverages included a collection of varieties of cacao obtained from Ceylon in 1883, a collection of different species of coffee assembled gradually, and Assam, China and Paraguay tea planted in 1891. In 1888 the cacao fruited well and it was stated that there was no reason for its failure if properly cultivated, and that it might be profitable in the Peninsula where the soil was better than in Singapore. In later years there was some demand for planting material for trial, but it never seems to have proved entirely satisfactory. In the nineties there was a considerable demand for liberian coffee for the estates in Selangor and Perak and some demand towards the end of that decade for Stenophylla. It is peculiar that so little interest seems to have been taken in the possibilities of tea cultivation during these years, seeing how promising it has shown itself to be in the last few years on both the plains and hills of this country.

The collection of fibre plants assembled in this Garden included Ramie, Cottons of various kinds, Manila hemp (*Musa textilis*), various species of Sansevieras (Bowstring hemp), Mauritius and sisal hemp, *Fourcroya gigantea* imported from Barbados and some Bromelias. Ramie cultivation attracted considerable attention up to about 1904 and Ridley had hopes that the cultivation of this and some other fibres would gradually come to occupy the definite place in the agriculture of the country which he considered that they deserved, but the overwhelming importance of rubber caused them to be neglected in later years. In the years 1903 and 1904 shortage of the cotton crops in America emphasised the importance of this cultivation throughout the Empire. Numerous varieties of this plant were imported but did not prove successful. Ridley states:—

> "The climate and soil of Singapore seems, however, quite unsuited for cotton culture, owing to the excess of rain, and the red cotton bug, *Dysdercus cingulatus*, in spite of the use of insecticides, destroyed nearly all the pods".

This conclusion was supported by that of the trials in Penang, referred to above, and agrees with the results of trials conducted in more recent years by the Department of Agriculture, S.S. & F.M.S., so far at least as the western side of the Peninsula is concerned. Mauritius hemp did well, but sisal was not a success. Both these plants grew satisfactorily in trials during the last ten years at the Central Experiment Station of the Department of Agriculture in Selangor, but they gave little prospect of profitable cultivation except at high prices for the fibre. The Sansevieras never became of much importance, but it is still possible that Manila hemp may prove a useful crop on certain types of soil in this country.

As early as 1888 the annual value of the preserved fruit export from the Colony, chiefly preserved pineapples, was $100,000, and in view of this Ridley imported in 1892, 1893, and 1895 better kinds of pineapples which included hot-house varieties from Kew and Windsor Castle and West Indian strains from Trinidad and Jamaica.

Various other kinds of fruits were imported and tried. It is impossible in the space available to enumerate these, but a few records of interest may be mentioned. Figs fruited in 1888 and the following year, but the fruits were of poor flavour. In the first of these years the tree tomato was a failure in Singapore, although it has in recent years grown and fruited well on the hills of this country. The avocado pear fruited well in 1892 and more seeds from Kew and Trinidad were imported. In view of its success both in Singapore and on Penang hill it is remarkable that even now this fruit, so popular in many parts of the tropics and sub-tropics, is still comparatively rare and of little account here. Mangoes from Madagascar and grafted kinds from Calcutta were imported in 1903, but the grafted kinds

of this fruit have so far never done well in this evenly moist climate. In 1890 Maltese lemons fruited well, giving fruits of good size and flavour, but even to the present day this fruit has attracted but little attention.

Summarising the results obtained with English vegetables in 1888, Ridley states that Tomatoes and Jerusalem artichokes did well, while turnips, onions and carrots gave fair results, though the flavour of the carrots was poor and they were apt to be small and stringy. In 1889 he mentions the successful cultivation of water-cress.

In 1907 when rubber was beginning to secure its place as the main crop, Ridley received numerous enquiries for suitable catch crops for planting in the young clearings. He was not able to give this matter the attention which he felt that it deserved, but in the following year he mentions that Ground-nut, Citronella and Lemon grass were in demand for this purpose.

Although in the early days of rubber planting the fetish of clean weeding held away, Ridley in 1909 planted up plots of crotalarias, tephrosia, desmodiums cajanus, clitoria and other leguminous plants which he considered suitable in various degrees for covering and improving the soil of rubber and other estates.

In 1907 an article in the "Agricultural Bulletin" called attention to the value of the Oil Palm as a cultivated crop and resulted in the distribution of 3,030 seeds. Substantial developments did not follow until some 10 more years had elapsed, but this record may well mark the beginnings of what is now a well established industry.

Considerations of space forbid reference to a number of other plants of various kinds grown in the Economic Garden in Singapore, but the following taken from the report for 1907 gives a picture of the extent of the planting material distributed :

Para Rubber seeds 405,600 and 13,100 plants, Ramie 3,170, Sanseviera 10,000, Manila hemp 130, Mauritius hemp 150, fruits of various kinds 1,700 plants and 12,000 seedlings, Tapioca 300 plants, Coffee 125, Citronella 160, Lemon grass 250, Camphor 750, Cocoa 160, Nutmeg 172, Oil Palm 3,030 seeds, Ground nuts 50 lbs. seeds. Most of these were sold to the Federated Malay States and Johore, but some went to Lagos, British New Guinea, Southern Nigeria and the Caroline Islands.

Pests and Diseases of Crops.

Early in his period of office Ridley drew attention to the damage caused to coconut palms by the black beetle (*Oryctes rhinoceros*) and the red beetle, as it was then known, (*Rhyncophorus sach*). The outcome of this was the passing in July, 1890 of the Coconut Trees Preservation Ordinance. Asiatic Inspectors were appointed in Singapore under the Director of Gardens and in Penang Settlement under the Superintendent of Gardens to

ensure that all suitable breeding places for these insects were cleared up. Similar legislation was provided about the beginning of this century in the Federated Malay States and until 1913 was administered by the Inspector of Coconut Trees and his staff.

In 1896 Ridley published a bulletin on the disease of nutmegs in Penang due to a Scolytid beetle and another on diseases of coffee. In 1899 he visited the districts in Selangor which were affected by the plague of the coffee caterpillar (*Cephonodes Hylas*) investigating its life history and trying experiments for its control. He also investigated and gave advice on certain disease of rubber and the white ant (*Termes gestroi*) attacking rubber and coconuts.

Among other pests and diseases recorded by him were Sireh disease on sugar cane in 1889 and in 1898 a borer caterpillar (*Chilo spp.*) and red smut fungus on the same crop, while there is also a record in the same year that the beetle *Xylotrupes gideon* damaged canes in Province Wellesley by eating the roots. In that year damage to coffee by a locust (*Cyracanthus nigrovaria*, Walk.) is noted and also by a fungus believed to be a species of Irpex. The Banana weevil (*Sphenophorus sordidus*) was recorded in 1899 together with the rose sawfly and a species of the fungus Rosellinia on the roots of a species of Ficus. In 1900 there is a note on the beetle, *Batocera octomaculata*, boring in the branches of Rambong (*Ficus elastica*); the life history of the caterpillar, *Calogramma festiva*, a Noctuid moth was worked out; and a caterpillar pest proved very destructive to young plants of Getta Percha.

In this connexion it is interesting to note that in 1909 Fox records that coconut palms on Malakoff Estate in Province Wellesley were badly attacked by the larvæ of a small moth and that for a few months the trees presented the appearance of having been burnt. Judging from this description it would seem that this constitutes an early record of an outbreak of the pest *Artona catoxantha*.

Agricultural Bulletin.

It was necessary for Ridley to find some means, additional to ordinary correspondence and personal visits, for conveying to the planting community information resulting from his various investigations and experiments. For this purpose he issued between 1895 and 1900 Agricultural Bulletins on various subjects, which were published as information became available. In October, 1901 he commenced to issue monthly "The Agricultural Bulletin of the Straits and Federated Malay States," which he continued to edit until his retirement in 1911. This was supported by numerous contributors and correspondents including officers of the Forests and Agricultural Departments established in the Federated Malay States during those years, as

well as several leading planters, but Ridley himself was always a regular contributor in addition to carrying out the considerable task of editor. This publication contains a mass of interesting and valuable information on a number of crops besides rubber, and shows, as do his other activities, that Ridley was no believer in placing all the agricultural eggs in one basket.

Horticultural and Agricultural Shows.

Another well recognised method of propaganda utilised by Ridley and his staff was the holding of Horticultural and Agricultural Shows. A Flower Show, often including fruit and vegetables, was held in Singapore in 1889 and the following two years, but was then discontinued. A successful Agri-Horticultural Show was held in Penang in 1893; another at Butterworth in 1899; and again in Penang in 1901. In 1904 a Show was held in Kuala Lumpur, but what was then described as probably the largest Exhibition of its kind ever held in the East took place in Singapore in 1906 and was attended by visitors and delegates from Java, India, Ceylon and Burmah. This was followed by Annual Shows at different centres such as Kuala Kangsar and Kuala Lumpur until 1910 when the last of the continuous series was held in Singapore.

It is hoped that the above account will give some conception of Ridley's multifarious activities on behalf of Agriculture in Malaya.

Since the days with which this article is concerned, the development of agriculture in the Federated Malay States, which resulted in the creation in 1904 of what is now the Department of Agriculture, Straits Settlements and Federated Malay States, and the establishment in 1926 of the Rubber Research Institute, has caused the transfer of agricultural investigation work from Singapore to Kuala Lumpur and as a result the Economic Garden in Singapore has been abandoned. Ridley himself lives far away, enjoying a well earned retirement in England. But in spite of these changes the agricultural structure which has arisen on the foundations which he so securly laid remains as his permanent memorial in Malaya.

MR. RIDLEY AND RUBBER IN MALAYA.

By B. J. Eaton,

Director, Rubber Research Institute of Malaya.

As the name of the late Mr. (later Sir) Henry Wickham is synonymous with the introduction of the rubber tree to the eastern tropics, so the name of Mr. Ridley is synonymous with the establishment of the Para Rubber Tree (*Hevea brasiliensis*) as a commercial plantation product in Malaya.

An anonymous article (probably by Ridley) published in the Agricultural Bulletin of the Straits and Federated Malay States (1903) gives the history of the introduction of the Para rubber tree into the Malay Peninsula. A few extracts from this article will therefore be appropriate in an appreciation of the work of Ridley in connection with rubber cultivation in Malaya.

On August 11th 1876 fifty plants derived from seeds received from Wickham on June 14th 1876 and grown in the Kew Gardens were sent to the Botanic Gardens Singapore. Owing to delay in payment of freight these plants all perished.

On June 11th 1877, twenty two plants were sent to the Singapore Gardens. In October of the same year Mr. Murton, Superintendent of the Gardens, planted nine of them in the Residency Gardens, Kuala Kangsar, F.M.S.

In a report dated February 3rd 1879 Mr. Hugh Low (then British Resident of Perak) writes "The Heveas are now 12–14 feet high. They take to the country immensely".

In a letter dated December 11th 1896 Sir Hugh Low writes to the Kew Gardens "As I am writing I should like to mention that the *Hevea brasiliensis* which having received from Kew through Singapore I planted at Kuala Kangsar in Perak grew magnificiently and fruited I believe 2–3 years before those of Ceylon. I distributed the seeds to various places in the neighbourhood and they are now to be found in Mr. Hill's Coffee Gardens in various parts of the peninsula and in several places in Perak.

"When Mr. Swettenham was at home in the summer I enquired of him as to their condition and found they were not thought to be of any value as some Dyaks had tapped some of the largest trees and found that scarcely any juice exuded from them (*Note:*—The effect of "wound response" on yield had not then been discovered). This unfortunate statement seems to have deterred Perak planters from paying any attention to Para rubber for some time". In 1882 other seeds obtained by Sir Hugh Low were planted by Mr. Wray at Kuala Kangsar.

In 1881 Mr. CANTLEY of the Botanic Gardens Singapore writes "the tallest Hevea (in the Gardens) is now 25 feet tall and 14 inches round the base. These trees commenced to fruit in 1882."

Later seeds were received in large quantities from Ceylon.

It was not until 1897 that the high price of rubber and low price of coffee stimulated the interest of planters (*Note:*—Had interest been aroused earlier and extensive planting taken place, the extraordinary boom of 1910 due to the rapid development of the motor industry would probably not have occurred).

Mr. RIDLEY served as Director of Gardens Singapore from 1888 until 1911. During most of this period—from 1888 until 1905—he was largely responsible for advising on agriculture throughout the peninsula, although during the later part of this period in the Federated Malay States, two Superintendents of Plantations in Perak and Selangor and a Federal Inspector of coconuts were employed by the Government before the inauguration of the Department of Agriculture F.M.S. in 1905.

Ridley thus remained in Malaya sufficiently long to see the fruition of his labour in regard to the commercial exploitation of the rubber tree (*Hevea brasiliensis*) in the extraordinary boom in rubber prices which reached its culminating point in 1910 and which was responsible for the subsequent extensive development not only in Malaya but also in the Netherlands Indies.

The writer of this article need make only a passing reference to the many-sided nature of his work in connection with other economic crops and in relation to his systematic work on the flora of Malaya, since this is being dealt with by others. Details of his work on numerous economic crops are contained in Annual Reports of the Botanic Gardens and Forests Department, S.S., of which he was also Director for some years and in the Agricultural Bulletin, S.S. which he initiated and edited for many years.

During the period prior to 1905 he was responsible for the distribution of an enormous amount of rubber planting material, seedlings and seeds from the experimental area planted in the Botanic Gardens Singapore, which formed the beginning of the oldest plantations in the peninsula. This activity is particularly noticeable from the years 1897 onwards. During this period also various systems of tapping and methods of coagulation were experimented with under his direction.

He also realised the possibility of utilising the seeds of the rubber tree as a source of oil, although for various reasons the marketing of seeds for this purpose has not developed on a commercial scale.

In 1903 he carried out certain manurial experiments with rubber plants in beds and showed the value of cattle manure in

improving growth. Experiments under his direction also indicated that early morning and evening tapping gave the best results.

In 1904 rubber seeds from the Botanic Gardens were sent to Burma and in the following year to Jamaica, Lagos and Nigeria. It is perhaps fortunate that these did not develop successfully in various countries to which they were despatched.

One interesting fact emerges from Mr. RIDLEY'S Annual Report for 1909 which is probably not known generally, *viz.* that the Government grant for the upkeep of the gardens was only sufficient to keep them in a respectable condition and was insufficient for tools, stores and improvements, so that the revenue derived from the sale of rubber and rubber seeds was used for this purpose. He had indeed to bemoan the fact that by 1909 plantation seed had become available—thanks to his distribution of seed in previous years—and was able to compete with his own sales. On this account he was seriously considering concentrating on running his rubber area as a plantation in order to make sufficient revenue from sales of rubber to enable him to continue improvements in other directions. It is obvious therefore that "retrenchment" is by no means new in the history of Malaya.

In this year also the records show that one tree in the Penang Gardens tapped every year (not continuously as at present) since 1885 had yielded approximately 52½ lbs. over the period.

It is also reported that "the success of this marvellous product reached a height little dreamt of a few years ago, prices well over 9 (shillings) a pound being realized". In spite of this however it is amusing to note in the report of the late Mr. FOX who served under Ridley in the Penang Gardens, that a small parcel of rubber sent home in October was withheld as the sales were unfavourable ! !

The honour of a C.M.G was conferred on Mr. RIDLEY on his retirement from Malaya and he was also elected a Fellow of the Royal Society for his botanical investigations.

In addition to continuing his publications on the flora of Malaya, he is still a member of the Technical Sub Committee of the London Advisory Committee for Rubber Research (Ceylon & Malaya) and thus continues at the age of 80 to maintain his interest in an industry of which he may be said to have witnessed the birth. Those of us who knew his personally as a fellow scientist and friend join in wishing him Many Happy Returns of the birthday which he celebrates this month. We in Malaya, not to mention other rubber growing countries in the East owe him a considerable debt of gratitude for his pioneer work in connection with the plantation rubber industry and his optimism and faith in its future.

MR. RIDLEY AND FORESTRY IN MALAYA.

It is never an easy matter to assess the value of the services of a biologist in any particular field, and when the boundaries of the fields are as obscure as those that surround forestry and agriculture, differentiation becomes impossible. Nearly every issue of the official organ of the Indian Forest Service———the *Indian Forester*———contains articles on crops that nobody in this country would connect with forestry, but which are regarded as coming within the purview of the Forest Department in India. Coming nearer home there is the case of rubber. Rubber started as a forest crop, but general responsibility for government activities and experimental work was, for purposes of convenience, subsequently vested in the agricultural authorities. Are Ridley's attainments in this field to be labelled forestry or agriculture? It may be supposed that Ridley was not particularly concerned at the time with the labels on the pigeon-holes in which posterity intended to docket the records of his activities, and we do not think that he will worry a great deal now if some of them have got a bit mixed.

That he was alive to the importance of maintaining supplies of timber goes without saying, and it is to Ridley that we owe the constitution of reserves in Malacca, whose forests would have been in danger of total dissolution during the rubber boom but for his foresight. The same applies to Penang, for aesthetically spoiled though that delightful settlement may be from the clearing of hill forest, it would have been completely ruined had reservation not put a stop to the (mostly unremunerative) efforts of cultivators on the hill sides. In Singapore, the reserves are of less importance and have been virtually abandoned. When Ridley arrived the damage had already been done, and the areas available for reservation were, for the most part, already past praying for as forests, though possibly worth considering for reafforestation, an aspect of forestry that loomed very much larger in the Straits when comparative ignorance prevailed with regard to the resources of the interior and communications were chiefly remarkable by their absence. Such plantations as were formed were, for the most part , confined to denuded tracts of country, and except for a patch of quite fair mahogany and some unhappy line plantings of high forest forms that continue to receive a certain amount of attention at Bukit Beruang in Malacca, little trace remains of these early efforts.

In 1895 Ridley paid a visit to Selangor and reported on the forests of that state which, at that time, were in nominal charge of the Land Officers, and it was largely due to his report that the first Forest Officer, Mr. B. H. F. Barnard was appointed in that State. He subsequently accompanied Mr. H. C. Hill, who was seconded from the Indian Forest Service to report and advise on

the forests of the F.M.S., a step which led to the appointment of Mr. A. M. Burn-Murdoch and the establishment of the Forest Department as a combined Federal and S.S. organization in 1900.

So much for his direct activities. Valuable though they undoubtedly were they were as nothing compared with his work in the field of systematic botany and plant economy. Thanks chiefly to Ridley, the Malayan forest organization was able to start off with immeasurably more knowledge of the composition of the forests than is the common lot of tropical foresters generally. Without his *Flora of the Malaya Peninsula* and *Malay Plant Names* most of our *Forest Records* would have been very incomplete or might never have been written. Though essentially a systematist he never allowed himself to be tied to the herbarium, and his contributions to the *Agricultural Bulletin* included invaluable field notes on timbers and on the uses and sources of all kinds of minor forest products. That there were inaccuracies goes without saying, but it was just that quality of recklessness in Ridley's work that enabled him to turn out such vast quantities of assimilable knowledge when it was most needed. A lesser man would have feared for his professional reputation, but Ridley was above such petty considerations. The work needed doing, and with the means at his disposal he did it magnificently.

Mr. H. N. RIDLEY AND THE FLORA OF THE NETHERLANDS INDIES.

By D. F. VAN SLOOTEN,

Acting Director, Botanic Gardens, Buitenzorg.

The series of island-groups, which extend from further India to Australia, and which are situated between 95° and 141° east longitude and between 6° north and 11° south of the equator, belong to the overseas territory of the Kingdom of the Netherlands, with the exception of the Philippines, Sarawak and British North Borneo, Portuguese Timor, Christmas Island and the Territories of British New Guinea. If one compares the extent and area of the Netherlands East Indies with those of Europe or the United States of America, one finds that the east to west extent of the N.E.I. is approximately equal to the distance from the West Coast of Ireland to the East Coast of the Caspian and from 7° to the West of San Francisco to 7° to the East of New York, the maximum length from West to East of the Netherlands East Indies (*i.e.* from Pulau Weh to Humboldt Bay) being about 5,000 km. The maximum distance from North to South is 2,000 km., which is equal to the distance between Oslo and Rome and as far as from the North coast of Michigan Lake to New Orleans (Louisiana).

The total area covered by all the islands of the Netherlands Indian Archipelago measures 1,900,152 km.², which equals about half the size of Europe, excluding Russia. In order to give some idea of the size of the islands we mention the following details: *Java*, including Madoera, has an area of 131,508 km.² (*i.e.* about the same size as the State of New York), *Sumatra* with the surrounding islands an area of 420,384 km.² (exceeding the area of Great Britain), *Borneo*, as far as the Dutch territory is concerned, covers an area of 553,341 km.² (which is as large as France), *Celebes* and the small islands in the immediate neighbourhood an area of 185,914 km.² (being about the same size as New Zealand and Ceylon taken together) and the Dutch section of *New Guinea* one of 397,204 km.² (*viz.* the same area as Japan proper), while the rest of the Archipelago measures 211,801 km.²

The botanists, who have to study the vegetation and the immensely rich flora of an area covering approximately 1,900,152 square kilometers, have to perform—as everybody will understand—a very difficult and lengthy task. Though the climatic conditions (uniformity of temperature and changes in rainfall, both intensified by the high mountain ranges which intersect the

islands) are very similar throughout this vast tropical area, so that the number of vegetation types is very limited, yet from the differences in the local soil conditions (water, edaphic factors, volcanic material, etc.) has arisen such a complex flora, that the very same vegetation-type shows in various places a large diversity as to the constituent flora-elements.

The total flora of flowering plants may confidently be estimated to comprise 30,000 species, belonging to about 2,500 genera. It will be many years yet before all islands of the Archipelago are intensively explored botanically and before such a wonderfully rich flora is thoroughly known, the more so as the flora of each island presents a small or high percentage of endemic species. This flora could not form a subject of systematic investigation until the foundation of the Botanic Gardens at Buitenzorg in 1817. Its study was taken up energetically by the second Director of the Gardens, C. L. BLUME, and has been continued up till the present.

This study is progressing but slowly, on account of the vastness of the territory, and also of the fact that during many years this task was entrusted to a few botanists only. Moreover, in Buitenzorg the standpoint is taken, that our knowledge of the flora ought to be based on a thorough monographic study of the families; this has found expression in contributions to the *Bulletin du Jardin Botanique de Buitenzorg*. To further this object, contact has long been developed with botanists from abroad for co-operation in the study of the Malaysian flora. The researches of those botanists who concern themselves with the study of a closely related flora, are therefore of direct importance. Many individuals are cited in literature as having studied more or less botanical material from this Archipelago. Among the most prominent of these is Mr. H. N. RIDLEY.

Mr. RIDLEY'S course of life once more proves how profitable it is for men of outstanding ability to be employed in the tropics for a considerable period of years; in this way important work can be accomplished without interruption and along the same lines. Well-known examples of this are the celebrated RUMPHIUS, TEYSMANN and TREUB, the last two of whom by their very long service in the tropics were able to found and consolidate the Botanic Gardens at Buitenzorg.

It has been given to Mr. RIDLEY also to spend a long period in the tropics, as a result of which he became one of the founders of our knowledge of the flora of the Malay Peninsula. Being evidently very zealous in fulfilling his botanical duties, he based the study of this flora not only on herbarium specimens, but also himself collected large numbers of plants during inspection trips.

His large collections, of which he deposited duplicate sets in many herbaria, including Buitenzorg, form, with other older ones, the essential basis of our knowledge of the exceedingly rich flora of the Malay Peninsula. He did not confine his trips to this Peninsula, but he also made expeditions to the Malay Archipelago, *viz.* to Christmas Island (1890 and 1904), Java (1915), Sumatra (1897 and 1921) and Borneo, as a result of which he was in a position to compare the floras of these regions. So far as the Netherlands Indies are concerned, it is only from New Guinea that he has studied an important collection of plants without having visited the country of origin. The number of species he named as new to science amounts to a few thousands; the number described by him from the Netherlands Indies (including British North Borneo, Sarawak and British New Guinea) so far as I have been able to trace—is 1,053, divided over the different islands as follows: British New Guinea 391, Sumatra and surrounding islands 329, Sarawak British North Borneo and Dutch Borneo 322, Java 6, Celebes 2, Ambon, Key and Aru Islands each 1.

Now it may be true that the majority of these plants described as new by Mr. RIDLEY originated from outside the Netherlands Indies; but phytogeographically the flora of the Malay Archipelago appears to be so closely related to that of the Malay Peninsula, that the systematic work of RIDLEY implies an important progress for our knowledge of the flora of the Malay Archipelago also.

Already before he became Director of the Botanic Gardens at Singapore, *viz.* in 1884, he published in the Journal of Botany some articles about the flora of the Malaysian Archipelago; the description of a new Bornean orchid (a new diagnosis of *Didymoplexis sylvatica* (Bl.) RIDLEY) belonging to the Javan collection of HORSFIELD, formed the first contact. In 1885 he described in the same journal a new *Carex* (*viz. C. tartarea* RIDLEY), collected in Sumatra by Dr. H. O. FORBES, while one year later he published a study on the Monocotyledonous plants of New Guinea, collected by the same (followed in 1925 by a study of FORBES's Javan and Sumatran Monocotyledones). Later, various contributions about the flora of the Malay Archipelago have been issued, most of them concerning Borneo and Sumatra.

RIDLEY made his first visit to Sumatra in 1897, to the Siak district in the South. He did not have a second opportunity for a visit to this island until 24 years later; he jumped at this occasion as he "was anxious to visit other parts of Sumatra before (his) Eastern travels came to an end". In spite of the great amount of work which has since been done, the beginning of RIDLEY's account of this botanical excursion to Northern

Sumatra, *viz.* to Brastagi and the Sibayak Volcano is still true: "The flora of Sumatra is at present still very little known, so that the account of even a short excursion especially in the quite unexplored northern part of the island is a contribution to the history of its flora". To know this history of the Sumatran flora as completely as possible is the prime requisite before cultivation, which is rapidly extending, makes it impossible for ever. Owing to the marked similarities that exist between the flora of Sumatra and that of the Malay Peninsula, a thorough knowledge of the flora of the latter territory is of the greatest importance in a study of that of Sumatra, though the Sumatran flora has certain peculiar characteristics, so that MERRILL'S opinion may be correct: "So far as I can judge at the present time, somewhere between 40 and 50 per cent. of the known Sumatran species are endemic, so that no published flora of any neighbouring region can be expected to be more than an aid to the determination of Sumatran material".

As to Borneo the words of RIDLEY in 1913: "very much remains to be done even in the best-known district", agree also with the present situation of 20 years later: on account of its enormous densely forested areas, sparse population, few roads and difficult transportation, Borneo has been only slightly explored botanically. How exceedingly rich its flora is, is illustrated by the extensive and very interesting Kinabalu collections made a few years ago by Mrs. MARY and Chaplain J. CLEMENS: these collections, among the largest ever made in Borneo, are very important to our knowledge of the Bornean flora, though that lofty mountain had already received attention from several botanists. RIDLEY himself, who visited Sarawak in September 1905, has written many essays about the flora of Borneo, working through the important collections made by Dr. HAVILAND and Bishop HOSE in Sarawak.

From the foregoing it is evident that Mr. RIDLEY'S work has in large measure been devoted to systematic studies: the name of RIDLEY will always be associated with work on the flora of the Malay Peninsula. He has further been much concerned with the geographical distribution of plants and with the development of species; his interest in these subjects finds expression in several of his published papers. This also may have underlain his great work entitled *"The dispersal of plants throughout the world"*, which begins as follows: "The study of the Dispersal of Plants .....is one of very great importance in its bearing on the distribution of plants throughout the world, the causes of their presence or absence in different localities, the changes of floras at different periods and all that goes to make a local flora. It has also been an important factor in the evolution of species, genera, and, in some cases, even of orders". For long years

considerable attention was given by him to this subject: already in 1905 in his description of the botany of Christmas Island, he devoted a detailed chapter to the dissemination of the plants of this island, which presented such an excellent occasion for his purpose, being a true oceanic island, as it "has never at any time been connected with the mainland of Java or with any other land", and as "it is an extinct volcano covered with coral reefs of various ages from the eocene period to the present day".

Moreover by his studies of economic plants, RIDLEY proved that there exists an admirable opportunity for co-operative productive work. Some of his publications are of such great importance for the Netherlands Indies, that they have been translated into Dutch. In *"The Timbers of the Malay Peninsula"* (De Maleische timmerhoutsoorten) timbers are concerned, which are distributed throughout the Malayan region. However, RIDLEY'S excellent study was a valuable addition to publications already existing, in which mainly Javan timbers were described, the descriptions of RIDLEY referring for the first time to timbers from Sumatra.

RIDLEY'S *Malay drugs* (De inlandsche geneesmiddelen der Maleiers) originated in 1894 from a lecture about the Malayan "Materia medica". The medicines, used in the Malay Peninsula, agree so well in nature and even in their names with those from Java and Sumatra, that in this case too the importance of a translation is quite conspicuous.

This very year MERRILL, who has also done so much for the knowledge of the Malaysian flora, has once more broken a lance for the value of international co-operation among scientists in the introduction of part 1 of the "Chronica Botanica" (1935). Let us finish with his words, for which he could have cited RIDLEY'S work in affirmation: ".....science is necessarily world-wide in its scope. An outstanding scientific development in one country is followed with interest and appreciation in all other countries, to a degree scarcely reached in any other group of thinking people. Particularly among botanists has international co-operation been developed, ever since the need of international co-operation was indicated through the development of its basic branch, Taxonomy. Plants are not subject to political boundaries, and the problems of plant science cover the world in all fields. The continued harmony among botanists in these days of stress, international discord, and internal difficulties, as widely separated as they are in the fields in which they specialize and the institutions of which they are a part, may well influence international co-operation among other groups".

SOME MALAYSIAN PHYTOGEOGRAPHICAL PROBLEMS.

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Perhaps no part of the world is more intriguing from the standpoint of phytogeography than is the great equatorial archipelago lying between southern Asia and Australia. Malaysia is by far the largest island group in the world, lies wholly within the humid tropics, has great diversity of altitudes up to nearly five thousand metres, and enjoys uniformly high low altitude temperatures, and, except in limited regions, an abundant rainfall. Almost continuous precipitation occurs over large sections, accompanied by relatively high humidity; other large areas are characterized by alternating wet and dry seasons. These factors, combined with the characters of the soils, the topography, and the position of mountain masses in relation to prevailing winds provide optimum conditions for plant growth, and the net result is a flora of tremendous richness and exuberance. The differentiation of species has perhaps been in part favored by the geologic development of the region, and its more or less insular character over long periods of time. Under present conditions contiguous parts of the same island may present rather strikingly different floras, while certain islands separated from each other by only relatively narrow arms of the sea may have very strikingly different vegetative and floristic aspects.

Some years ago on the basis of a study of endemism of those parts of Malaysia blessed with published floras or compiled enumerations, such as the Malay Peninsula, Java, Borneo, and the Philippines, I concluded that when the flora was approximately known, that in the Pteridophytes and the Spermatophytes combined its total would approximate to 45,000 species. Thus for the Malay Peninsula, Borneo, and the Philippines, considering all known species, it was found that at least fifty per cent. of those known from each major unit were endemic. Considering how relatively little was then, and still is, known regarding the floras of the large islands, including Sumatra, Borneo, Celebes, and New Guinea, I am inclined to consider that this estimate of 45,000 species is perhaps too conservative.

With a land area in excess of one million square miles, this region (including the Malay Peninsula, which is almost an island, and which is essentially a part of the Archipelago) extends from northern Sumatra to Java, New Guinea, and the Philippines, a region of magnificent distances, extending from north-east to south-east, a distance of over forty-five hundred miles. Among its many thousand islands are found the largest ones in the world: New Guinea, Sumatra, and Borneo, and such large

secondary ones as Java, Luzon, Mindanao, Celebes, Gilolo, and Timor. The magnitude of some of these major islands is well suggested by Wallace's statement that within Borneo "the whole of the British Isles might be set down, and would be surrounded by a sea of forests."

This is one of those parts of the world regarding which we have only an approximate knowledge of its flora. Certain areas, such as parts of the Malay Peninsula, Java, and parts of the Philippines, may be considered to be well-known botanically, but in fact only certain very limited parts are thoroughly known. Vast regions have been only superficially explored, and great areas have never been visited by any collector or botanist. A distinctly high percentage of the known species is known only from the single collections on which the original descriptions are based. We cannot, therefore, make any reasonably accurate comparison between any particular part of this vast region and comparative areas in what may consider to be thoroughly explored parts of Europe and North America. In any consideration of the numerous phytogeographical problems of Malaysia we are handicapped by our own limited knowledge of its exuberant flora, and must realize that future intensive exploration will yield data which may conceivably alter some of our at present accepted axioms.

Although the geologic history of Malaysia is reasonably well understood in its salient outlines much detailed knowledge is lacking. The magnificent work of the Dutch geologists and hydrographers on the geological history of Malaysia forms a basis that must be considered by those biologists interested in the present-day distribution of plants and animals, for the key to present-day distribution to a large degree is found in geologic history. Whatever the causes may have been, it seems to be evident that the great islands of Sumatra, Java, Borneo, and the Palawan-Calamian group in the Philippines were in the Pleiocene-Pleistocene at times connected with the Asiatic continent, and New Guinea had the same relationship with Australia. There is much evidence to support the idea that most of the Philippine group, Celebes, Lesser Sunda Islands, and the Moluccas, at this time in geologic history, as well as in the Tertiary, were constantly archipelagic, with no direct land connections between eastern and western Malaysia, and hence no direct land connections between Asia and Australia since the early Tertiary.

Botanists, probably because confronted by such myriads of species, have not been as prone as zoologists to delimit life zones or to map provinces. The attempts of the zoologists to establish lines of demarcation separating the Asiatic and Australian faunas are interesting. Wallace's line extending northward from between Bali and Lombok through the Macassar Strait between Borneo and Celebes is, at least popularly, the best known of these. Its most noteworthy substitute is Weber's Line, farther

to the east. If these lines are plotted on a hydrographic map the former approximates the eastern boundary of the Asiatic continental shelf and the latter the western boundary of the Australian-Papuan shelf. It is reasonably good evidence that these two shelves mark the approximate limits of previously existing continental areas. These two more or less stable areas have been constantly separated by a triangular unstable insular area, its base the Lesser Sunda Islands, its apex Luzon.

There is no sharp line of demarcation between the Australian and the Asiatic faunas and floras, but rather this unstable insular area forms a great transition zone that has been in part populated by infiltrations from the south and east and from the north and west. No proposed line is absolute for any single group, much less when all groups are considered.

It is a well-known fact that as we progress southward and eastward from Asia, the continental types of animals and plants become fewer and fewer, and as we progress northward and eastward from Australia, the Australian types likewise decrease even more markedly. This is exactly what we would expect if our present concept of the geologic history of the region is approximately correct.

One should not make the mistake of drawing final conclusions on the basis of the present-day distribution of any one group of organisms, whether it be the molluscs, insects, reptiles, birds, freshwater fishes, mammals, or plants, and much less on any single family or genus within these major groups; and yet there are conspicuous cases of broad generalizations that have been founded on the study of a single family, perhaps even a single genus. While some such generalizations may ultimately prove to be correct, it is always safer to consider what is known regarding the geographic distribution of other and perhaps totally unrelated groups and to attempt to correlate such data with what is known of the geologic history of the entire region. It is a safe assumption that the different groups have been developed and have attained their present-day distribution at different periods in geologic history; and that while some groups were rapidly differentiating, others were perhaps static or were retrograding. That the Philippine flora, as to the Myrtaceæ, shows an unmistakably close relationship with that of north-eastern Australia is no reason for considering that the entire Philippine flora and fauna is allied to that of Australia. If one studies only the Dipterocarpaceæ of the Philippines one would conclude that its flora is overwhelmingly allied to that of Borneo, Sumatra, and the Malay Peninsula. Clearly here, as with other groups, the periods of development and expansion have occurred at different times in geologic history, periods that permitted the distribution of one group perhaps restricting that of another.

Botanical collectors who have explored Malaysia compared with those who have worked in Europe and in North America, north of Mexico, have been few, and the number of botanists who have familiarized themselves with what has been published is fewer still. For all practical purposes those botanists who have concentrated on a study of the floras of the Malay Peninsula, Sumatra, Java, Borneo, the Philippines, and New Guinea, in the past two hundred years are merely the pioneers, and their work should be considered as that of pioneers, to be correlated, polished, and evaluated by future generations of botanists who will have infinitely more to work with than did those who first exploited the fertile fields of Malaysian botany. It will be many years before the essential data are assembled on which we may base final conclusions. Even such work as has been done by various taxonomists on the Malaysian flora working in scattered centres in Europe, England, and America, in Manila, Singapore, Buitenzorg, and Calcutta, has not been well correlated. Much needs to be done to prove the validity or non-validity of some thousands of proposed species. Many points can be settled only when competent taxonomists, having access to comprehensive collections, shall have had the time and opportunity to prepare and publish authoritative revisions of numerous natural groups. As this is done, and as type collections and other authentic material are critically studied and the species carefully compared with each other, nomenclatural changes and many reductions of proposed species will be the order of the day. In accordance with the current aims and methods of botanical work such changes will be inevitable. In the more thoroughly explored parts of the world, and in those countries where their floras have been long and intensively studied, we approach a condition of finality but in such vast regions as Malaysia, where great areas still remain to be explored and even existing collections have not been intensively and comparatively studied, our taxonomic conclusions cannot be other than approximate.

It has long been known that within Malaysia we find what we consider to be Asiatic and Australian types. To a much lesser degree we find scattered African and Mascarene types from the west, Polynesian ones from the east, and New Zealand and New Caledonian ones from the southeast. Both the Asiatic and Australian types include high and low altitude forms. In reference to the high altitude and some of the low altitude Asiatic types we are reasonably confident that they actually are continental in origin, because in such genera as *Taxus, Pinus, Ulmus, Salix, Acer, Primula, Gleditsia, Lilium, Anemone, Sedum, Rosa, Buxus, Potentilla, Lysimachia, Aster, Solidago,* and many others, the numerous species are characteristic of the north temperate zone of both hemispheres. The occurrence of scattered species in Malaysia is unquestionably due to the fact that somehow at some

time in geologic history these representatives of northern genera extended their ranges southward into Malaysia and have persisted there.

As to the Australian types in Malaysia such as *Eucalyptus, Centrolepis, Patersonia, Drimys, Clianthus, Stackhousia, Pimelea, Tristania, Leptospermum, Melaleuca, Xanthostemon, Halorhagis, Didiscus, Stylidium,* and others, we can also be reasonably certain that they are true Australian types because of the great development of these genera in Australia and, to a certain degree, in New Caledonia; and that the few representations in Malaysia migrated northward into the archipelago even as the Asiatic types migrated southward into Malaysia.

There are, however, a very large number of genera common to north-eastern Australia and Malaysia and southern Asia and Malaysia, some covering the entire range from Asia to Australia, whose origins it is practically impossible to determine and to assign to Asia rather than to Malaysia or *vice versa.* Doubtless many of these were originally Malaysian and extended their ranges southeastward to Australia and northward to Asia, but many others probably Asiatic. Their universal distribution within the monsoon region is unquestionably in part a reflex of the adaptability of these plants to a certain type of climatic conditions.

There are relatively few African and Mascarene types in Malaysia, such as *Angræcum, Combretodendron (Petersia, Petersianthus), Erythrophlæum,* and *Baphia,* but definitely they are African and Mascarene because the principal development of species in these genera (at least *Erythrophlæum, Angræcum* and *Baphia*) is found in those regions. When we come to the so-called Polynesian types in Malaysia, such as *Vavæa, Joinvillea, Dolicholobum, Tetraplasandra,* and *Couthovia,* the present indications are that they are not really Polynesian types in Malaysia but are actually Malaysian types in Polynesia, the generic types merely having been first described from the latter region. Thus *Vavæa* is now known to occur from Java, Borneo, the Philippines, and New Guinea; and New Guinea in definitely the center of origin and dispersal of *Couthonia* and of *Dolicholobium. Joinvillea* and *Tetraplasandra,* both small genera, have Malaysian representatives.

The numerous definitely Asiatic types in Malaysia apparently followed certain distinct routes of migration into Malaysia from the continent. In the west unquestionably the most important route was through the Malay Peninsula to Sumatra, Borneo, Java, and even further to the south and east. Considerable evidence leads us to believe in the existence of a secondary western route from Asia through the Andaman and Nicobar Islands to Sumatra. In the east, considering the fact that certain Asiatic types occur in the Philippines and in Celebes, but are absent from other parts of Malaysia, there was apparently another route from southeastern Asia to Formosa and the Philippines and

southward. We find in Formosa and on the higher mountains of northern Luzon certain Himalayan types, in many cases these representing the most eastern and southern extensions of the Himalayan flora.

Increasing knowledge of the biology of Malaysia is tending more and more to confirm the belief that there have been two great centres of origin and dispersal of tropical types, one in the west, the Sunda Islands, Java, Borneo, Sumatra, and the Malay Peninsula, and one in the east, New Guinea. From the latter plants and animals migrated southward into eastern Australia, eastward into Polynesia, and northward into the Philippines, few extending westward to the Sunda Islands From the Sunda Islands the striking migrations were northward into tropical Asia, northeastward into the Philippines, and to a more limited degree eastward and southward in the direction of New Guinea. There were, of course, intermigrations within each area.

Comparative studies of the climates and plants in tropical Asia and Malaysia with those of America, emphasizes one striking difference. In America the humid tropics are to a large degree separated from the temperate regions by extensive arid areas. In the Old World the intervening arid regions are lacking. There has been a continuous humid north and south route connecting Malaysia with subtemperate and temperate parts of Asia—the Malay Peninsula northward through Burma, Siam and Indo-China, to India and southern and eastern China. The limiting factor here has been largely temperature, while in America it has been aridity and temperature combined. We have little evidence on which to base conclusions as to what the humidity and aridity of the various parts of Malaysia may have been in past geologic times, but the available paleobotanical evidence seems to indicate continuously humid tropics in the past, in general similar to the conditions existing to-day.

Outside of the taxonomic field, but nevertheless intimately associated with and dependent upon it, there are an infinite number of problems to be settled regarding the Malaysian fauna and flora. In part these depend on an intensive study of existing collections of reference material, in part on long continued intensive field work. What was the original flora of Malaysia? What are to be considered the relic species of earlier floras? What factors permitted or encouraged the inter-migration of Australian-Malaysian and Asiatic-Malaysian types and what were the limiting factors? Were these geological or climatic in nature, or both? Does the theory of continental shift throw any light on the problem? What are the relations between the present distribution of plants and the prevailing winds? What bearing do typhoons have on the problem? What is the relationship of existing ocean currents to the spread of plants? What does the annual north and south flight of certain types of migratory birds signify for those plants characterized by the production

of myriads of minute seeds and adapted to muddy or wet habitats? What are the effects of constantly moist and alternatingly wet and dry conditions? What is the effect of dominant mountains and mountain ranges on prevailing winds and *vice versa*, and how do these factors affect vegetation? What is the bearing of geologic history and of hydrography and topography on the problem?

From long residence in the tropics and from numerous observations made on the vegetation, some years ago I reached the general conclusion that in modern times man is the most important single factor in the dissemination of plants. Manifestly much of Malaysia was originally covered by a forest vegetation of one type or another. To-day vast areas are under intensive cultivation, almost equally large areas are in primitive cultivation, enormous tracts are covered with coarse grasses, bamboo thickets, and second growth forests. Man's agricultural activities have been the greatest single factor in the destruction of the original forests over vast areas, but lumbering, and in some regions mining, has played a part. It is axiomatic that in Malaysia a primary forest once destroyed is never re-established directly; its place is taken by coarse grasses, bamboo thickets, or dense stands of rapidly growing small trees and shrubs. As the primary vegetation has been destroyed the habitats have been provided for plants from other regions. These, accidentally or intentionally introduced by man, or through the agency of nature, once man has paved the way for them, have become dominant over great areas. Many of these were of American origin, introduced since the sixteenth century, including representation of such woody genera as *Leucæna, Psidium, Lantana, Pithecellobium* and *Prosopis*, and a very large number of weedy herbaceous plants in such genera as *Drymaria, Malachra, Waltheria, Stachytarpheta, Cassia, Hyptis, Ageratum, Cosmos, Elephantopus, Erechtites*, and *Synedrella*, as well as numerous grasses and sedges. Antedating these numerous American introductions were many Asiatic types, and this introduction of Old World forms is still progressing. There is much that needs to be done in reference to the history of these introduced plants. Where did they come from? When were they introduced, and how? What are the reasons for their present dominancy? What is the percentage of introduced species in primary forest areas as compared with the percentage in those regions where man is directly or indirectly responsible for the present vegetation?

Endemism presents numerous fascinating problems. Throughout Malaysia one finds in most of the large genera a few strongly characterized, widely distributed species. At the same time in these genera one notes that in such groups as *Ficus, Antidesma, Eugenia, Medinilla, Dendrobium, Quercus, Eria, Bulbophyllum, Calamus, Aglaia, Begonia, Polyalthia*, and *Canarium*, to mention only a few, that there is a tremendously

developed local endemism in many of the larger islands and even in some of the smaller ones. Invariably the percentage of endemics is very low in the settled areas, open grass lands, and secondary forests, and correspondingly is very high in those groups that require primary forest conditions. One concludes that the primary forests represent the original vegetation, and that the low percentage of endemics in the settled areas, open grass lands, and secondary forests is a reflection of the activities of man on the vegetation as a whole; that many of the species now dominant in these latter areas were introduced as the primary forests were destroyed. We are reasonably certain that this was the case in reference to the many species of American origin, which predominate in the settled areas, for these did not commence to come in until some time during the sixteenth century. We are less certain in reference to those species of Asiatic origin, largely groups characteristic of the second growth forests and open grass lands.

The cultivated plants represent a series of problems in themselves. Most of those in Malaysia are not natives of the archipelago but were introduced by man from other regions. The earliest invading peoples probably brought no plants for they had no agriculture. Later waves of more advanced peoples certainly brought cultivated plants with them. Many basic Malaysian food plants were introduced in prehistoric times, others in modern times; and the introduction of weeds parallels the introduction of economic species. Within the period of western expansion the Malaysian flora has been greatly enriched through the introduction of numerous economic plants and many weeds of American origin.

Not to be disassociated from the cultivated plants are their aboriginal names, which in many cases point definitely to the place of origin and the approximate time of introduction of individual species. In these fields of ethnobotany and comparative philology of plant names much needs to be done, and Malaysia with its very numerous dialects and its great racial mixtures offers a marvellously fertile field.

Again in the field of plant biology there are numerous problems. The relationships between insects and plants, birds and plants, and even bats and plants in reference to cross pollination. The biological relationships between ants and such domiciliary plants as *Hoya, Dischidia, Myrmeconauclea, Neonauclea, Macaranga, Lecanopteris, Polypodium, Dæmonorops, Myrmecodia, Hydnophytum, Myrmedoma, Saurauia,* and *Piper,* and representatives of other genera where plant organs such as branches, stems, leaves, and sheaths have been modified to form domiciles for colonies of ants. But this and numerous other subjects is outside the scope of this paper.

In this brief survey, hurriedly written because of the exigencies of my present situation, and entirely undocumented, I have attempted merely to enumerate some of the numerous intriguing problems of Malaysian phytogeography. I have done so in the hope that some who read it may be tempted to assist in solving some of the problems by undertaking field work in this too little explored part of the world or to co-operate in the study of the rich reference collections already available. In Malaysia one is constantly on the edge of the botanical unknown. The field is vast, existing problems create further ones, and the need of more investigators is great. The serious-minded interested student who elects to assist in the study of the plants and plant problems of Malaysia will be amply repaid by the productive results secured.

THE DISPERSAL OF PLANTS BY FRUIT-EATING BATS.

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Many data are at our disposal about the dispersal of plants by birds, both endozoically and exozoically. Very little, however, is known about the part played in plant dispersal by fruit-eating bats. They are probably as important as the birds, but exact observations are mostly lacking. In H. N. Ridley's well-known handbook on the "Dispersal of Plants throughout the World" three pages are filled with what is known of plant dispersal by bats. These data are based partly on his own observations made during his long and fruitful stay in the tropics, and partly they have been taken from literature. In the same work upwards of 130 pages are given to seed dispersal by birds.

Fruit-eating bats occur in the tropics of the old and of the new world, but they are most numerous in the tropical territories of Asia and Australia. Little is known about their way of living, though they can be observed everywhere. In the twilight these bats come forth from their sleeping places, just like the insect-eating species, and look for their food during the night, to turn back again to their sleeping places at day-break. A few species, *viz.* of the genus *Pteropus*, the Fox-bats, hang down from the branches of large trees, in great numbers together, during the daytime. Others hide themselves, resting in holes, or under folded leaves of palm-trees, or in dark parts of the forests, as I observed several times in Krakatau. In the lake-plains of northern New Guinea I saw large troops, consisting of thousands of individuals, flying low in great circles above the vast *Saccharum*-marshes, during the hottest hours of the day. The animals circled in a quiet, regular flight above the grass covering, and it seemed as if they were asleep. When they were startled by a gun-shot, they flew restlessly in all directions, finally to unite again into the rotary flight. Above these marshes this phenomenon seems to be observed regularly; in 1926 I myself saw it four times, and also during former expeditions it seems to have been perceived, for this place, which is a large island in the river Mamberano, has received the name of Kalong Island, *i.e.* island of flying foxes.

Sody[1] mentioned a few particulars about the modes of life of fruit-eating bats in captivity. These animals seem rarely to be kept in captivity, but Sody succeeded in keeping a female of

1. Sody. Iets over vruchtenetende vleermuizen in gevangenschap. De Tropische Natuur. Vol. XVII. 1928, p. 179.

Cynopterus sphinx tithœcheilus, and her young alive for a considerable time. According to him both specimens were hostile to approach. At Bandoeng, I myself kept a specimen of *Pteropus* species in my aviary for a long time; it was very affectionate, crept up my coat, and nestled its head against my neck. According to Sody they seek food late in the evening, take it along to the higher parts of the cage, and eat it while hanging down. Sometimes they hang down by one leg only, using the other to hold the fruit in front of them. In the field he observed that this species broke off the fruits of *Piper aduncum*. Unfortunately nothing is said about the food eaten by the animals in captivity, only that they got soft fruits. Nor are any data given about the digestion of fruits, and the excretion of seeds.

The fruit eating bats mainly live on fruits, but other parts of plants are eaten also. The fruits eaten by these animals are either soft or hard. Soft fruits which are taken may be berries, soft drupes, figs, and gourds. But they eat also fruits with a hard, or rather hard, fruit-shell. These are mainly the larger drupes. These are torn off with the beak, and brought back to the resting places, to which the animals return again and again. They usually choose a spot near the tree from which they gather the fruits, using a branch, roof-gutter, or prominent parts under the roofs or galleries of houses, to hang from. The soft or hard wall is partly or completely gnawed off from the kernel, and the latter is simply dropped. Often they seem to take the fruits along over greater stretches on returning at dawn to their sleeping places, for below them fruit-kernels and seedlings are often found. At Buitenzorg, near my laboratory, there stood a few old specimens of *Corypha Utan*, in which roosted a colony of *Cynopterus sphinx tithœcheilus*. The animals slept in the old, more or less folded and drooping leaves. Under these trees the grass was partly killed by the excreta, but a number of plants developed from the fruits taken home by the bats, and eaten there. They sometimes drop the fruits undamaged during the flight. During the time the large *Canarium commune* bore fruits in the Botanic Gardens, at Buitenzorg, we could often hear the heavy fruits banging down on a zinc pent-house.

These animals probably cannot cover great distances with these heavy fruits. Observations, however, are lacking, and it would indeed be very difficult to make any. But yet many fruits and plants which I found under the above-mentioned sleeping places at Buitenzorg, must have been carried for a distance of hundreds of metres, because in the immediate surroundings of the *Corypha* there were no fruit-bearing trees from which the bats could have taken their food. As the animals

are very voracious, and often eat only a part of the fruit-flesh, these large colonies must destroy enormous quantities of fruits. For the dispersal of fruits over moderate distances they must undoubtedly be of the greatest importance.

VAN DER PIJL[1] tells in an article of recent date that the fruit-flesh is not eaten straight away, but chewed, sucked, and ejected. These animals have a very narrow gullet, measuring in case of *Cynopterus* 2 to 2½ mm. And almost without exception, the intestinal canals of these animals are filled with a colourless jelly. The larger species of *Pteropus* too are said not to contain any seeds in the intestinal canals. MC. CANN[2] also found only a mucous fluid in the intestines of *Pteropus giganteus*, although the animals had eaten fruits of various species of *Ficus* only a short time before. VAN DER PIJL, however, mentions that seeds of *Ficus fistulosa* have been found in the newly evacuated excrement of a *Cynopterus sphinx*, and that the intestines of *Cynopterus brachyotis*, which had eaten the catkins of *Piper aduncum*, contained seeds of this plant.

According to VAN DER PIJL, fruits eaten by bats have certain characteristics, *viz.* inconspicuous colour, a smell which is neither fresh nor agreeable, large size, large kernels, hard flesh, while the part of the plants from which the fruits are taken is near open spaces. Such fruits are actually found in the food of bats, but many others, besides which are juicy, fragrant, small, and soft. At any rate, these animals are important because they eat many fruits which are despised by most fruit-eating birds.

Most remarkable is, according to VAN DER PIJL, the cauliflory of many fruits eaten by bats. He observed the following fruits eaten by bats: *Achras Zapota, Anona muricata, Averrhoa Carambola, Bouea macrophylla, Canarium* spec. div., *Carica Papaja, Ceiba pentandra, Cynometra cauliflora, Elæocarpus Ganitrus, Eugenia javanica, malaccensis*, and *polyantha, Ficus fistulosa*, and *glomerata, Garcinia Mangostana, Lansium domesticum, Mangifera cæsia, fœtida*, and *indica, Musa paradisiaca, Melia Azedarach, Nephelium lappaceum, Persea americana, Psidium Guajava, Phyllanthus acidus*, and *Emblica, Sechium edule, Spondias*, and *Zalacca edulis*.

In case of species of large fruits with large kernels only the wall is eaten away, but the soft fruits with small seeds are eaten either whole, or part of them. A great number of seeds are

1. L. VAN DER PIJL. Zaadverspreiding door vleermuizen. De Tropische Natuur, Vol. XXIV. 1935, p. 131.
2. MC. CANN. Notes on the flying fox (*Pteropus giganteus*). Journ. Bomb. Nat. Hist. Soc. Vol. XXXVII. (Quoted from VAN DER PIJL.).

eaten together with the flesh in which they are imbedded. In the case of figs they are really small fruits covering the inner wall of the receptaculum, but I will call them "seeds". The juicy fruits are digested in the intestinal canal, and the seeds come forth undamaged together with the excreta. These excreta are dropped, not only in the resting places, but also during the flight, so that the seeds can come down in all kinds of places. They are hardly ever found on the ground, because here they are hidden between plants, but often on leaves, stones, and walls. The excreta are of a very fluid consistency, often jelly-like. I often saw the seeds of *Piper aduncum* on leaves in the surroundings of Buitenzorg. I saw leaves with excreta containing seeds of *Ficus* in Krakatau, where there is a very great number of two species of fruit-eating bats, *Cynopterus Horsfieldii* and *C. sphinx tithœcheilus;* in the higher parts of the same island I found excreta principally containing seeds of *Cyrtandra sulcata*. The excreta also often come down on buildings, and young plants of *Ficus Benjamina* and of *F. retusa* can often be seen growing in the gutters. When the seeds come down on old, badly kept buildings, or on old temples, then the roots of these large species of Ficus can slowly break the stones asunder, and do much damage.

The animals need not rest while eating these juicy fruits, and thus the seeds can be carried over greater distances than in the case of big fruits with a hard kernel. It is not known how long a time the seeds need to pass through the intestinal canal of bats in the digestive process. It would be important to study this.

In the islands north of Batavia there are large colonies of *Pteropus,* and the animals fly over to the shore of Java, late in the afternoon, or early in the evening, in order to look for food. When at sea one can often see large groups of these animals crossing wide sea-arms. Undoubtedly these animals have played a part in the dispersal of seeds to the islands of the Krakatau-group. It is not known when these animals have arrived there. JACOBSON[1] who examined the fauna of these islands in 1908 fails to mention them, but in 1919 they were quite common, and DAMMERMAN[2] mentions them in 1922.

The first to write about plant dispersal by bats was RUMPHIUS, in his well-known Herbarium Amboinense. He mentions *Nauclea elegans, Artocarpus integra* and *communis,* besides *Anona mucosa,* and two species of *Mangifera,* the seeds of which are spread by bats. In addition many data can be found in the above mentioned work of RIDLEY.

1. E. R. JACOBSON. De nieuwe fauna van Krakatau. Jaarverslag van den Topographschen Dienst in Nederlandsch Indië over 1908. Batavia, 1909, p. 192.
2. K. W. DAMMERMAN. The fauna of Krakatau, Verlaten Island and Sebesy. Treubia, Vol. III. 1922, p. 65.

An examination of the contents of the intestinal canals of these animals might produce important results. Up till now only a few facts are known. One might also collect the fruits and seeds from the excreta. Another way of carrying out the investigations with a greater chance of success, is the observation of plants which regularly come up under the sleeping and resting places of these animals. During the many years which I stayed in Java, I noted down, here and there, which species of plants occurred in such places. In a few cases it was not possible to recognize the species of plant from the young, non-flowering materials. It appeared from these observations that numerous species of plants are spread by these bats; the appended list, undoubtedly, does not contain all the species which are actually eaten and dispersed. The list, moreover, shows that it is mainly species of trees from which the bats take their food. Yet one sees among them also smaller plants, such as *Clibadium surinamense, Passiflora fœtida,* a *Zingiberacea,* and an Aroid.

Some plants owe their quick dispersal mainly to these animals. *Piper aduncum* is a small tree which has been imported to the Botanic Gardens at Buitenzorg from tropical America. The trees, which are 2 to 6 m high, often bear large quantities of fruit-catkins, which are principally eaten by the smaller species of fruit-eating bats. Owing to this the plant has spread very quickly in the surroundings of Buitenzorg, and farther in West Java. Large quantities occur in grass jungles, in valleys, and in kampong wildernesses, where often it may crowd out the original flora.

Below is given a list of the species of plants which I have found. Most observations have been made in Buitenzorg, but also in Batavia, Bandoeng, Samarang, Cheribon, and other smaller places, wherever I had the opportunity. As I was not able to state the species of bats, I give the list without indicating them. Among the plants found in Buitenzorg there are several species of trees which are cultivated in the Botanic Gardens.

Young plants found under the resting and sleeping places of fruit-eating bats :—

MORACEÆ

1. Artocarpus communis FORST.
2. ,, elastica REINW. et BL.
3. ,, integra MERR.
4. Ficus ampelas BURM.
5. ,, Benjamina L.
6. ,, callosa WILLD.
7. ,, elastica ROXB.
8. ,, fistulosa REINW.
9. ,, fulva REINW.
10. ,, hispida L.
11. ,, infectoria ROXB.
12. ,, pilosa REINW.
13. ,, retusa L.
14. ,, septica BURM.
15. ,, variegata BL.

URTICACEÆ.

16. Pipturus incanus WEDD.

PIPERACEÆ.

17. Piper aduncum L.
18. ,, retrofractum VAHL.

EUPHORBIACEÆ.

19. Antidesma Bunius SPR.
20. Baccaurea racemosa M. A.

ANONACEÆ.

21. Anona muricata L.
22. Species ignota.

LAURACEÆ.

23. Litsea polyantha JUSS.
24. ,, species.

FLACOURTIACEÆ.

25. Flacourtia Rukam Z. et M.

PASSIFLORACEÆ.

26. Passiflora fœtida L.

CARICACEÆ.

27. Carica Papaja L.

GUTTIFERÆ.

28. Calophyllum Inophyllum L.
29. ,, species.
30. Ochrocarpus congregatus BOERL.

LEGUMINOSÆ.

31. Cynometra cauliflora L.
32. Maniltoa gemmipara SCHEFF.

MYRTACEÆ.

33. Eugenia aquea BURM. f.
34. ,, malaccensis LAM.
35. ,, polyantha WIGHT.
36. ,, species.

COMBRETACEÆ.

37. Terminalia Catappa L.
38. ,, species.

MELASTOMATACEÆ.

39. Melastoma malabathricum L.

MALVACEÆ.

40. Durio Zibethinus L.

ELÆOCARPACEÆ.

41. Elæocarpus species.

RUTACEÆ.

42. Evodia species.

BURSERACEÆ.

43. Canarium commune L.
44. ,, species.

MELIACEÆ.

45. Aglaja species.
46. Dysoxylum species.
47. Lansium domesticum CORR.
48. Melia Azedarach L.
49. Sandoricum Kœtjape MERR.

ANACARDIACEÆ.

50. Gluta Renghas L.
51. Mangifera indica L.
52. ,, species.
53. Spondias dulcis FORST.

SAPINDACEÆ.

54. Nephelium lappaceum L.
55. Sapindus Rarak DC.

EBENACEÆ.

56. Diospyros species.
57. ,, species.

LOGANIACEÆ.

58. Fagræa species.

RUBIACEÆ.

59. Morinda citrifolia L.

CUCURBITACEÆ.

60. Trichosanthes species.

COMPOSITÆ.

61. Clibadium surinamense L. var. asperum BAKER.

ZINGIBERACEÆ.

62. Amomum species.

MUSACEÆ.

63. Musa species.

PALMÆ.

64. Actinophlœas angustifolius BECC.
65. Arenga pinnata MERR.
66. Bactris speciosa KARST.
67. Caryota Rumphiana MART.
68. Corypha Utan LAMK.
69. Livistona rotundifolia MART.
70. Oncosperma filamentosa BL.

ARACEÆ.

71. Colocasia species.

OPEN AIR HOTHOUSES IN THE TROPICS AT 3100 METRES ALTITUDE.

By C. G. G. J. van Steenis,
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In this article I discuss the ecological and morphological reponse of some plant species to the action of fumaroles in the highlands of Java and Bali. I also discuss briefly the dispersal of some of these plants.

In June of this year I climbed Mt. Ardjoeno[1] in East Java. This lofty volcanic mountain complex, attaining more than 10,000 feet above sea level, is built upon a fault running north and south.[2] It consists of 5 separate peaks, the northernmost of which is called Mt. Welirang. Welirang is the Javanese name for sulphur, and this peak is so called because of the occurrence of several enormous solfatara, which have been commercialised for centuries, probably even in Hindu times. Numerous Hindu monuments are found on Mt. Ardjoeno at nearly 10,000 feet altitude in the form of remains of well built rooms. Even today on several Javan mountain peaks priests live a poor life and offerings are regularly made by the people.

The southernmost peak of the mountain complex is Mt. Ardjoeno itself in a restricted sense. This peak, the highest of all, is practically extinct. It does not possess such huge craters and solfatara as Welirang. Between Ardjoeno and Welirang there are three other peaks of lesser altitude. The southernmost and lowest is Mt. Bakal, a rough and rocky, extinct lava-stop. The two others are both called Kembar; we shall distinguish them as Kembar S. and Kembar N. Both are characterised by the occurrence of numerous fumaroles near their summits. They are reached easily along the road from Trètès to Lalidjiwo; in the latter place there is a resthouse at about 2500 m. altitude, situated within the pure *Casuarina Junghuhniana* forests, which cover the entire northern side of the mountain. From Lalidjiwo one reaches the pass between the Kembars, 2900 m. altitude, in about one hour and a half. Near the pass I observed the first small and hitherto unrecorded fumaroles in the northern of the two blowholes. The soil, consisting of weathered volcanic rock, is hot, and steam—which condenses immediately at this altitude—is continuously produced.

1 *Oe* in Dutch is pronounced as *ou* in *would*
2 Cf. N. J. M. Taverne, Vulkaanstudien op Java (Vulkan. Med. Ned. Ind. 7, 1926, p. 109, seq.)

It is a well known fact that the local distribution of mountain plants is often very curious. So for instance *Lycopodium clavatum*, L. and *Gaultheria fragrantissima*, Wall. have only been found on the Kembar peaks, but never on the much loftier Welirang or on Ardjoeno itself.

From the pass I climbed Kembar S., which is 3100 m. high, in about half an hour, over the gently sloping northern ridge, which is covered by a very short vegetation of small herbs such as *Styphelia pungens*, Koord., grasses such as *Danthonia pilosa*, R. Br., *Festuca nubigena*, Jungh., *Tripogon exiguus*, Buese, and especially *Imperata (lalang)*, and several orchids such as *Thelymitra javanica*, Bl., and *Microtis unifolia*, Rchb. Remains of charcoal from burned shrubs confirm our idea, derived from the occurrence of lalang, that the absence of forest is due to fire and to the grazing of deer. Deer are very common here, as shown by their numerous droppings, especially towards the summit. I had very bad weather, and made my way upwards first in a cold drizzle, then under heavy rain. Whereas all the slopes, except the ridge towards the pass, are covered by fairly tall tjemara forest, the top region proper is devoid of forest. It consists of a horseshoe-shaped ridge in the centre of which a so-called *sawahan* is situated, that is a cup-shaped basin covered entirely with the tuft grass *Festuca nubigena* Jungh. Everywhere on the summit steam escapes from cracks in the hot rock; the peak may be said to be more or less crowned by numerous steam clouds. It was a very agreeable sensation to sit on the hot soil within reach of the steam, which escapes under pressure with a dull droning sound. Less agreeable is the smell which is halfway between that of a rotten egg and that of a phalloid. However, no SO_2 was observed. The natives told me that deer came here at night to sleep.

A very peculiar vegetation is developed round these fumaroles, and it shows a distinct zonation. Some metres from the centre, where the steam loses its heat, *Lycopodiums* (*L. cernuum*. L. and *L. clavatum*, L.) thrive in a rather dense thicket along with *Gleichenia linearis*, Clarke and some poor tjemara, only one metre tall, densely clad with *Usnea*. Still nearer to the steam-holes the vegetation is much lower and consists of a carpet of very small herbs. Here *Lycopodium cernuum*, L. shows a very peculiar modification, becoming a flat plaited mat of hardly 1 dm. thickness, covering several square metres. It has just the appearance of a moss (Pl. 1). Other weeds are also able to approach the hot steam, namely a common lowland Rubiacea, *Oldenlandia herbacea*, L., which I was very astonished to find in such a peculiar locality, forming

a very low dense mat. Still other weeds show the stunted dwarf habit. These are *Fimbristylis capillaris*, A. Gray, and also, though less typical, *Lindernia crustacea*, F. v. M., *Senecio sonchifolius*, Moench, and a *Blumea*. All of them, however, do not form mats. Moreover, *Lindernia* and *Fimbristylis* are found elsewhere in Java in dwarf forms, notably on poor soil, *e.g.* on gravel round houses. It must be noted that *Lycopodium cernuum* and *Oldenlandia* are found thriving more luxuriantly some metres away from the steam spouts. Hence the **fumarole modification is effected by the tolerance of these plants.** All the plants mentioned live in continuously humid and warm surroundings, which I call an open-air hothouse in a temperate mountain zone. The wind often alters its direction and sways the steam clouds all over the summit ridge and on account of this several of the plants mentioned occur scattered amongst the lalang. In some places swollen semiglobular white cushions of the moss *Racomitrium* lie loosely on the hot wet rocks.

After I had made these observations I unexpectedly received confirmation of the phenomena described when my friend C. N. A. de Voogd, chief forester of Bali, etc., sent me a collection of plants from the Lesser Soenda Islands and gave me permission to publish concerning them. He collected in 1934 on Mt. Agoeng, the highest peak of Bali island, 3100 m. altitude. It is thus of the same height as Mt. Kembar. Agoeng also has fumaroles on the top ridge and there De Voogd collected some other plants which show the same steam habit as the Kembar plants. He too collected the stunted form of *Oldenlandia herbacea*, L. (Pl. 1) and also found some lowland plants in the Bali open air hothouse, *viz. Mitrasacme nudicaulis*, R. Br., *Bidens pilosus*, L. and *Senecio sonchifolius*, Moench. His best finds were, however, the steam-modifications of two species which I did not get on Kembar—of *Dicrocephala chrysanthemifolia*, DC. and of *Hyptis brevipes*, Poit., the former a mountain plant, the latter a typical lowland plant (Pl. 1). Mr. de Voogd informed me that the fumaroles of Mt. Agoeng also produce steam without any smell of SO_2. He camped on the summit ridge and his coolies pitched a tent above one of the fumaroles to keep warm. The condensation of the steam during the night, however, caused "rainfall" in the tent, so that this idea turned out to be less practical than it was ingenious.

It is definitely shown that steam, at least that of fumaroles at high altitudes in the tropics, has a very uniform effect on plants which are not in the least allied to one another. It is of interest to note, too, that the steam does not diminish fertility, as both *Oldenlandia* and *Fimbristylis* were in flower.

The sketches given above lead to another general consideration. The question arises how these lowland plants were dispersed to this high altitude. *Dicrocephala chrysanthemifolia* and *Lycopodium cernuum* are of general occurrence in the Javan high mountain zones, but what about *Oldenlandia* and the others? Of these common weeds (only *Mitrasacme nudicaulis* being decidedly rare) we have abundant herbarium material at Buitenzorg, and on the labels of most specimens the altitude is noted. From this material, collected throughout the Malaysian region, I made the following table of the greatest altitudes:—

In Malaysia from sealevel up to:	Malaysia	Kembar	Agoeng
Bidens pilosus, L. ...	c. 2100 m.	—	3100 m.
Hyptis brevipes, Poit. ...	c. 1200 m.	—	3100 m.
Lindernia crustacea, F. v. M.	c. 1450 m.	3100 m.	—
Mitrasacme nudicaulis, R. Br.	c. 1700 m.	—	3100 m.
Oldenlandia herbacea, L. ...	c. 1450 m.	3100 m.	3100 m.
Senecio sonchifolia, Moench.	c. 2000 m.	3100 m.	3100 m.

This table shows distinctly that there is a distinct gap between the common occurrence in the lowlands and the hills and that near the fumaroles on the mountain tops. This cannot be attributed to the absence of waste ground, where these pantropic weeds generally grow, in the mountains. On the contrary, waste ground is very common on the mountain slopes, where natives burn the vegetation, cut paths, build houses and try to cultivate crops such as maize and potatos. I am of the opinion that the plants concerned cannot stand the cold of the higher mountain zones above 2000 m. This would fit in with their occurrence in local hotter spots, such as the fumaroles.

The question of vertical dispersal still remains. In the case of the only Composite, *Senecio sonchifolius*, Moench., the pappus is no doubt responsible for dispersal by ascending winds, which, as I observed frequently, may be very strong. But the other plants do not possess any special means for wind dispersal. Neither their seeds or their fruits are fleshy and *endozoic dispersal* seems out of the question. **Exozoic dispersal must be held responsible.** Their seeds or fruits are all small and inconspicuous, as are the plants themselves. The only notes on their methods of dispersal that I could find in Ridley's well-known work "Dispersal of Plants throughout the World" are that *Lindernia* may possibly be dispersed by mud on birds' feet,

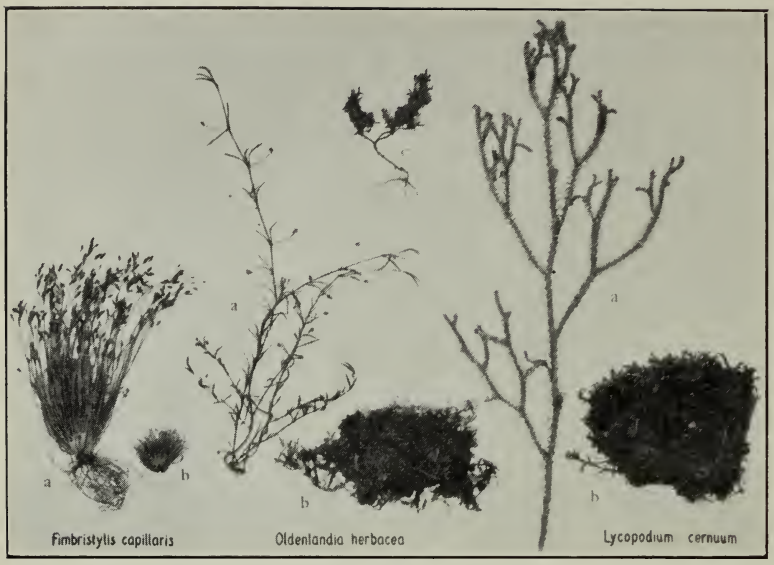
Oldenlandia washed away by rain, and that it might further be possible that the adhesive calyces of *Hyptis* and the pappus of *Senecio sonchifolius* and of *Bidens* could become entangled in the hair and feathers of animals.

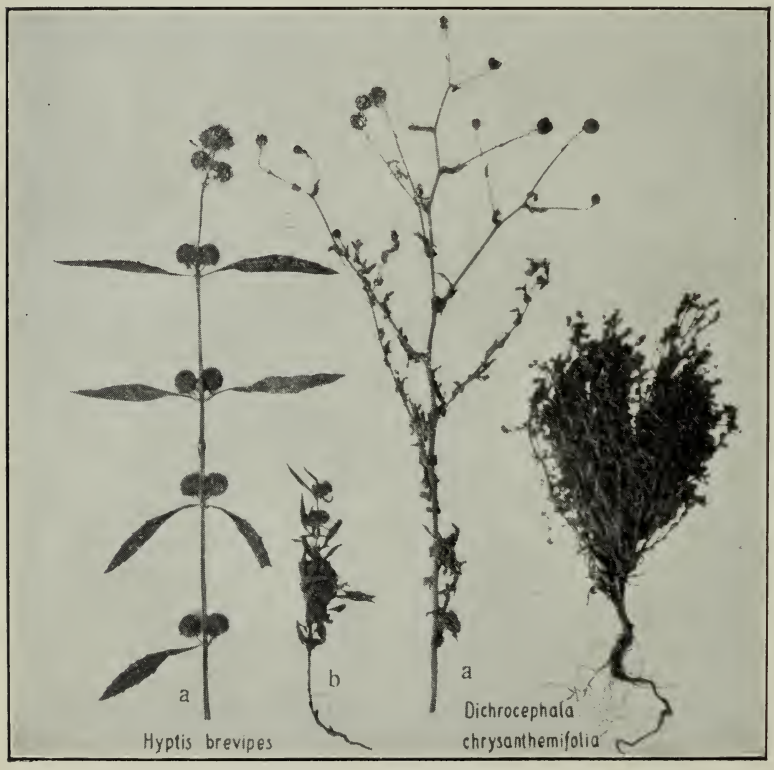
I prefer to put forward the following hypothesis. It is common knowledge that deer migrate through the forests not only in a horizontal but also a vertical direction. Mr. W. H. de Kramer[1] wrote on migration of tiger, python, bear and pig during the fruiting season of the durian (*Durio*) in South Sumatra. The then prevailing western winds bring the smell of durian towards the interior, attracting the pig, and with the latter comes the whole fauna living on them. Migration of elephant and of rhinoceros from sea level to high up the mountains is well known. In January 1935, it was observed that on the north slope of Mt. Slamat in Central Java a continuous migration downwards of the fauna, including deer, was taking place. The natives attributed this to a future eruption, which the animals knew by instinct was coming.[2] That their instinct proved to be at fault does not matter here. It might be that the grazing on higher levels was poor at that time. It is a fact that several animals when old migrate to mountain tops to die in solitude, the reason for which is unknown. Several notes on this phenomenon have been published in our semi-popular naturalists' journal "De Tropische Natuur".[3] I may mention here of the animals found on high mountain tops—often dead—the flying squirrel (at 3675 m. on the summit of Mt. Smeru and at 3800 m. on the summit of Mt. Kerintji), the *kambing utan* (the Sumatran mountain goat) and a rat on the top of Mt. Kerintji, 3800 m., several birds, black monkeys (*Semnopithecus maurus*) on Mt. Smeru and so on. It seems to me that exozoic dispersal by migrating animals, either ascending or descending for food supplies, for dying or for other reasons is the most reasonable explanation of the occurrence of lowland plants near fumaroles. The seeds may adhere with mud to hair or feathers, or, as seems more probable to me, to the hooves and feet of animals, and be occasionally dispersed in that way. They may adhere in no less degree to the master of all animals, man, who frequently visits mountain tops and may unintentionally carry with him seeds from lower down. I refer especially to the statement made above of priests living and people making offerings on mountain summits, a practice which dates back to

1 De Tropische Natuur 23, 1934, p. 119-120.

2 Verslag Ned. Ind. Ver. tot Natuurbescherming 1933-1934, p. 33, 1935.

3 Cf. volumes 19, 1920, p. 197, and 20, 1931, p. 57.


a
b
Fimbristylis capillaris
a
b
Oldenlandia herbacea
a
b
Lycopodium cernuum


a
Hyptis brevipes
b
a
Dichrocephala
chrysanthemifolia

Hindu times. De Voogd informed me that the Balinese regularly make offerings on the summit of Mt. Agoeng, and that many monkeys live there, feeding partly on these offerings. These grey monkeys seem to be more or less accustomed to the presence of man, as they took small pieces of bread without hesitation. De Voogd also found a skeleton of a monkey on the summit of Mt. Agoeng.

The gap in altitudinal distribution I believe to be due to the fact that these plants are not able to thrive, or at least to settle, between the highest border of distribution and the abnormal high altitude of the fumaroles, of which the hot soil and atmosphere offer lowland conditions. It would be of great interest to make field experiments on this matter. It would be interesting, too, to make experiments in the laboratory to discover the physiological effect of steam on plants. I do not know of any such experiments. Can the tufted fumarole habit of plants be brought about artificially in the laboratory by the continuous action of pure steam? And in all plants? I much regret that I cannot give any exact data regarding the temperature of the fumarole steam. All I can say is that even near its point of escape it was quite bearable on the human skin.

Plate 1. Modifications of plants by fumaroles, the left figures of each species with the normal, the right with the abnormal habit. *Fimbristylis capillaris,* A. Gray, *a,* from Mt. Tengger, *b.* from Kembar S., x ½; *Oldenlandia herbacea,* L., *a.* and *b.* from Kembar S., *c.* from Agoeng, x ¼; *Lycopodium cernuum,* L., *a.* and *b.* from Kembar S., x ¼; *Hyptis brevipes,* Poit., *a.* from medium altitude, *b.* from Agoeng, x ⅓; *Dicrocephala chrysanthemifolia,* DC., *a.* and *b* from Agoeng, x ⅓.

SEMEIOCARDIUM ZOLL., A MISINTERPRETED GENUS OF BALSAMINACEÆ.

By C. A. Backer,

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In the Natuurkundig Tijdschrift voor Nederlandsch Indië XVII (1858–59), pp. 243 seq. the celebrated ichthyologist P. Bleeker published a letter, dated 8 August, 1858, written to him by the Swiss botanist-collector Heinrich Zollinger, then residing in the Dutch Indies, on the Natural History of Madura, a small island north of the eastern part of Java. In this letter Zollinger describes a trip made that year by him over the island in the company of N. A. Th. Arriëns, then Resident (*i.e.* Commissioner) of Madura. On page 245 of his description Zollinger says: "A new genus of the family of Balsaminaceæ "is perhaps the most important discovery. The plant grows on "naked calcareous rocks between 600 and 800 feet above sea "level and has entirely the structure of the common Balsams. "Instead of a spur one of the petals bears a short sack ending in "two obtuse points. The same petal" (this is an error; see description below) "is provided at its apex with a beautiful cordate "standard. On account of this character I have called the plant "*Semeiocardium arriensii.* To my regret I found only two ripe seeds which, however, did not germinate."

Here matters rested until J. K. Hasskarl in 1863 (Annales Musei Botanici Lugduno-Batavi, I, pp. 142 seq.) gave a monograph of Indian Polygalaceæ. He examined *i.a.* the type-specimen of *Semeiocardium arriensii* collected by Zollinger (No. 3956) bearing on its ticket the note: "corolla 4-color; vexillum cordatum, "cyaneum, albido-marginatum; saccus bifidus, luteus, purpureo-"maculatus". The flowers of Zollinger's specimen being clearly in a bad state of preservation Hasskarl not only could not find the sack or spur but moreover was led into the error of mistaking the plant for a Polygalacea. The genus Semeiocardium, of which he gave no diagnosis, was retained by him and he brought to it, besides *S. arriensii* Zoll., three species from British India. Of *S. arriensii* he gave a diagnosis, but his description of the inflorescences, flowers, fruits and seeds, apparently taken from another specimen, is entirely erroneous.

In Hooker's Flora of British India 1, 201 (1872) Alfred W. Bennett reduced the three Indian species of Semeiocardium to *Polygala triphylla* Ham., a plant which does not occur in Java, nor in Madura. He did not mention *Semeiocardium arriensii.*

R. Chodat in his *Monographia Polygalacearum,* 2me partie (Mémoires de la Société de Physique et d'Histoire Naturelle de Genève XXXI, Seconde Partie, 1892/93, p. 41), apparently not

having seen good specimens of *Semeiocardium arriensii* considered Semeiocardium to be a section of Polygala. To this section he reckoned, besides *Polygala triphylla* Ham., only the insufficiently known *P. cardiocarpa* Kurz. *Semeiocardium arriensii* Zoll. was reduced by him to *Polygala triphylla*.

I myself, having seen only very bad materials, committed the same mistake in my *Schoolflora voor Java* (1911), p. 77.

But in 1915 I had, thanks to Dr. J. C. Koningsberger, then Director of the Buitenzorg Botanical Gardens and an ardent promotor of the floristic investigation of Java and surrounding islands, the occasion of making a botanical trip to Madura. On this trip I had the good fortune to re-discover the plant evidently meant by Zollinger, who was, after all, much too able a botanist to mistake a Balsaminacea for a Polygalacea. The plant, which showed the characters mentioned by Zollinger in his short description, and which grew indeed on calcareous rocks, proved to be a true Balsaminacea, nearly related to Impatiens but differing from this genus (*see* below) by the 2 lateral and the 2 posticous petals being all of them connate into a rather large, bifid standard, and by the 4-celled (not 5-celled) ovary. In 1919 a slightly differing form of the same species was discovered by me in the Kangean Archipelago (east of Madura). I succeeded in bringing over living plants and seeds to the Buitenzorg Botanical Gardens. The seeds germinated poorly, but seeds thrown out by cultivated plants germinated now and then, always on rocks. In 1930 plants, offspring of those raised from seeds collected in Kangean, were still living in the Buitenzorg Gardens.

I give below a description of the genus and the species, based on living plants.

SEMEIOCARDIUM Zoll. (descriptio emendata).

Cymæ axillares paucifloræ. Flores more generis Impatientis resupinati, zygomorphi, bisexuales, majusculi. Sepala 3; duo lateralia alte connata, tenuiter membranacea; tertium posticum (antrorsum versum) majus, petaloideum, cymbiformi-infundibuliforme, breviter calcaratum; calcare distincte bilobo, antrorsum spectante. Petalum anticum (retrorsum vergens) liberum; duo lateralia quam cetera minora, fere ad apicem usque connata cum unguibus posticorum (specie anticorum); laminæ petalorum posticorum connatæ in vexillum antrorsum vel deorsum spectans, incisurâ angustâ fere ad medium usque bifidum; hisce 4 petalis connatis floris labium inferius biunguiculatum fingentibus. Stamina 5; filamentis liberis, brevibus, latis, ovarium celantibus; antheris crassis, in tubum brevem connatis; loculis apice poro magno dehiscentibus. Ovarium oblongum, 4-loculare; loculis pauciovulatis. Stylus 1, brevis, subulatus; capsula lineari-oblonga, 1-5-sperma; valvulis 4 elastice dissilientibus, semina ejaculantibus. Folia alterna, longiter petiolata, ovato-lanceolata, leviter serrata. Herba annua, erecta, patule ramosa; caule valde succulento; radicibus brevibus.

Genus Impatienti proximum sed bene diversum petalis 4 superioribus (specie inferioribus) in laminam bifidam, biunguiculatam connatis, necnon ovario 4-loculari.

Species adhuc unica :

Semeiocardium arriensii Zoll. (*see* the plate).

Cymæ breviter pedunculatæ, 1-3-floræ; pedicellis 10-16 mm. longis. Sepala lateralia oblique deorsum spectantia, mucronulata, pallide viridia, 10-18 mm. longa, 7-11 mm. lata. Sepalum posticum a lateralibus partim tectum, mucronulatum, album vel pallide flavum, intus pulchre rubro-striatum et rubro-guttatum. Calcar inter sepala lateralia occultum, 3-7 mm. longum, latum, basi et apice angustatum, petalum anticum ovali-ellipticum, 7-11 mm. longum, 6-9 mm. latum, viride, dorso carinatum; carina acumine recurvo terminata. Petala lateralia quam postica multo breviora; ungues petalorum posticorum curvati; labium (a petalis lateralibus et posticis formatum) late ovale, 15-20 mm. longum, in speciminibus madurensibus pallide violaceum, infra incisuram cum macula intense violacea, basi sæpe notatum punctis rubris quasi continuationem efformantibus punctorum striarumque sepali postici (unde error zollingerianum), in speciminibus kangeanensibus candidum, basi luteum. Tubus antherarum recurvum (specie procurvum). Ovarium glabrum. Capsula glabra, ± 20 mm. longa, 5-6 mm. lata. Caulis crassus, apice pubescens, deorsum glaber. Petioli 10-70 mm. longi; foliis ovato-oblongis, basi obtuso-rotundatis, apice acute acuminatis, leviter serratis, junioribus subpubescentibus, adultis glabris. Herba erecta, annua, 40-80 cm. alta.

Crescit præcipue in rupibus calcareis.

Distributio:—Madura (Backer 20268, 20911).

Archipelago Kangeanensis (Kangean et Paliat) (Backer 26962, 27376, 27409, 27863, 27950, 29565, 29966, 30004).

Semeiocardium arriensii Zoll. — Photo made in 1917 after a specimen cultivated in the Buitenzorg Botanic Gardens, raised from seeds collected in Madura.

THE FLOWERING OF TEMBUSU TREES (FAGRÆA FRAGRANS *Roxb.*) IN SINGAPORE, 1928—1935.

By R. E. Holttum.

The gregarious flowering of the Tembusu trees (*Fagræa fragrans* Roxb., or *Cyrtophyllum fragrans* DC) which are so abundant, both wild and planted, in the neighbourhood of the town, is one of the most striking seasonal phenomena to be observed in Singapore. Beautiful at all times, with their finely moulded masses of foliage, at the flowering season the trees are transformed by their host of small creamy-white fragrant blossoms. For a fortnight or more, some of the suburbs of the town are filled with their heavy fragrance, both day and night. This impressive spectacle occurs nearly always in April or May (usually May), and is followed in August by the almost equally impressive general fruiting of the trees, accompanied by nightly visits of hordes of giant fruit-bats. The whole phenomenon is one of the most regular features of the somewhat irregular general behaviour of plant life in Singapore. It is fairly certain that such a general flowering, as in other similar cases, is a response to some definite climatic change, and the question naturally arises what such a change could be.

In the Gardens Bulletin S.S. Vol. V, pp. 173-206, I gave an account of my observations on periodic leaf-change and flowering in Singapore, chiefly as regards deciduous trees, during the years 1927-1930. In the introductory part of that paper is a short account of the salient features of the climate of Singapore, and to this the reader is referred for further details. The distribution of rainfall throughout the year, though on the average very even, is so irregular in detail, and the incidence of dry weather so uncertain, that many species of plants which are native of seasonal climates behave quite abnormally. As regards the native evergreen trees, it appears that any pronounced dry spell will cause most of them to flower, provided they have had an appropriate period in which to recover after the previous flowering and fruiting season. Some trees respond very quickly to the dry weather, and flower within two or three weeks; others take much longer to develop their flowers. It is fairly clear however that most of them are dependent on pronounced dry spells, and that their flowering is much less regular than that of the Tembusu.

We have therefore to look for a seasonal phenomenon, perhaps relatively slight and not always effective on most trees, which is as regular as the flowering of the Tembusu. The one almost regular feature of our climate is the rather sudden break in the wet weather which usually comes some time in January. The wet season, which is most intense in November and December, is characterised by cloudy skies, prolonged slight drizzling

rains, and a very high general atmospheric humidity, with little bright sunshine and no drying winds. The actual rainfall may not be very heavy, but it has a far greater effect than at other times of the year, when heavy showers, followed by bright sunshine, are the rule. Then rather suddenly, usually in January, the cloudy weather ceases, and there is a shorter or longer period of drying winds. This drier weather may not last very long, but its onset, after the rather depressing wet season, is very noticeable.

The thought therefore occurred to me that perhaps the Tembusu trees are very sensitive to this change from prolonged wet to drier conditions, responding even though the dry weather is not sufficiently intense to affect some other trees. I have examined the rainfall records made at the Botanic Gardens during the period of my observation on the trees, and believe that they indicate a definite relationship between the change of season and the onset of flowering of the Tembusu. The irregularities of one are followed by irregularities of the other, and the last wet season, by stopping at an unusually early date, gave a most instructive example. Unfortunately the figures showing change of rainfall do not give a complete account of the climatic changes; the actual change, as above remarked, is accentuated by the presence of clearer skies and drying winds. The figures given are however perhaps enough to demonstrate a connection between the phenomena concerned.

The Tembusu tree is slow in all its activities. Its growth is slow, but seems to be an almost continuous process, unlike that of most evergreen trees, which produce new flushes of leaves at intervals of a few months (or sometimes many months). The development of flower buds is slow; though the flowers are quite small, the buds take something like two months from the time they are first visible to the opening of the flowers. The inflorescences are borne in the axils of quite young leaves; at flowering, the subtending leaves are usually the second pair from the apex of the shoot. Then the fruits, though small, take more than three months to ripen (it is usually about three and a half months from the height of the flowering to the full ripening of the fruit crop). These slow processes are perhaps connected with the soil conditions favoured by the trees, which grow best in the very hard compacted soil formed as a result of exposure to rain and sun. Under such conditions very few other trees will thrive. The soil is very slightly pervious to water and air. I have seen tembusu trees in the neighbourhood of Palembang (Sumatra) growing in swampy ground, and they also grow under similar conditions in Pahang; possibly the lack of aeration is the chief character in common between the swamp conditions and the compacted clay of Singapore. It is notable that the palms Oncosperma and Cyrtostachys, both native of wet ground, also flourish in hard clay soils suitable to the Tembusu.

In addition to the heavy flowering which is usual in May, the trees often have a subsidiary flowering towards the end of the year, in October or November, and occasionally a few flowers may be seen at other times. I have noted particularly the behaviour of three individual Tembusu trees from the latter part of 1927 up to the present (the observations are not quite complete, especially as regards the subsidiary flowerings, which are often not easy to observe). I have also noted the seasons of principal flowering of the trees in Singapore generally, and any pronounced subsidiary seasons. The main flowerings are therefore all noted, but not all subsidiary flowerings. Of the three individual trees, one stands almost alone, and has its lower branches intact and widely spreading over the ground all around it; the others are near other trees, one on a hill and the other in a more sheltered position near the bottom of a slope. They are referred to as E, X and P respectively.

The exact date of the beginning of flowering is not easy to fix; I have therefore indicated a date at which a general flowering was well in progress, perhaps a week after the first flowers open. As regards subsidiary flowerings, they are so incompletely recorded that I only quote here a few cases when the flowering was fairly general, or when one of the trees had rather numerous flowers at an unusual time.

I have indicated below the dates at which wet weather ceased, giving rainfall for the previous ten days, and for the week or more of dry weather following. It will be seen that general flowering is in progress about four months after the onset of the dry weather. To test whether the flowering dates could be connected with the length of the dry period, or with the time at which wet weather followed the dry, I examined the subsequent rainfall figures, but the incidence of subsequent rainfall and its amount are so variable that it appears most unlikely that it can have any effect on the time of flowering. As regards sudden dry weather following wet at other times of the year, this is rarely so pronounced as in January, as heavy rainfall at other seasons is usually of the heavy shower type; figures of relative humidity and perhaps of duration of sunshine would also have to be added to give a full account of the climatic conditions. However, I have traced some of the more pronounced subsidiary flowerings to dry weather following heavy rain, and these are indicated.

As the time from the stimulus to flower-development to the ripening of fruit is about seven months and a half, and as it is unlikely that further stimuli during that period could cause anything in the nature of a second general flowering, it is most unlikely that two full flowerings could occur in any calendar year; a second flowering would always be a subsidiary one, and probably affects those trees or branches which have for some reason not been affected by the main flowering. Flowering on

separate branches is a not uncommon phenomenon on trees of various kinds in Singapore; also leaf-change on one branch at a time.

In connection with the following figures, it may be noted that the average rainfall of the wettest month in the year (December) is about 12 inches, while May and June, which on the average are the driest months, have about 6 inches each; but the rainfall in any one calendar month varies considerably from year to year.

PRINCIPAL FLOWERINGS.

1928

Rainfall January 5–14 7.99 inches
15–21 .14
Flowering: May 12

1929

Rainfall December 28 (1928)—January 6 5.62 inches
January 7–13 .15
Flowering: May 5.

1930

Rainfall January 3–16 4.01 inches
17–26 .07
Flowering: May 20

1931

Rainfall January 15–22 5.22 inches (Jan. 12–14, 4.28 ins.)
January 25–February 2 .24 inches
Flowering: middle of May.

1932

Rainfall December 21–30 (1931)
December 31–January 5 .07
Flowering: May 1.

1933

Rainfall January 16–25 4.19 inches
January 26—February 1 .04
Flowering: May 27.

1934

Rainfall December 17–26 (1933) 3.81 inches
27–January 2 .00
Rainfall January 12–21 8.55
22–Feb. 3 .00
Flowering: April 25–June 10.

NOTE:—The duration of flowering was recorded by Mr. Corner, and he did not note whether the main flowering began on April 25th. As a heavy flowering usually lasts for at least three weeks, two flowerings, one caused by dry weather

beginning December 27, and the other January 22, would produce the effect of a continuous flowering. The dry period December 27–January 2 was followed by more heavy rain, and then a more intense dry period, which evidently caused a second flowering.

1935

Rainfall November 28–December 7 (1934) 3.44 inches
December 8–27 .07

Flowering: April 7.

SUBSIDIARY FLOWERINGS.

1928

Rainfall September 30–October 9 (1927) 6.33 inches
October 10–21 .12

Small flowering on trees E & X, 19 February 1928.

Rainfall July 3–12 4.89 inches
13–30 .12

Small flowering on trees E & P, also general small flowering about November 11.

1929

Rainfall June 19–28 6.24 inches
26–July 12 .02

Small general flowering October 27.

1930

Rainfall November 26–December 5 (1929) 3.68 inches
December 6–15 .20

Tree X with many flowers on low branch, and tree P with some flowers, April 20 and 26.

Rainfall June 13–22 8.62 inches
23–July 5 .00

October flowering not noted, but tree E had many fruits ripening early in February 1931.

1931

Rainfall June 2–11 4.34 inches
12–20 .11

Tree X fairly full flowering in October.

1933

Rainfall November 30–December 9 (1932) 3.29 inches
December 10–19 .17

Small general flowering April 16, 1933.

1934

Rainfall July 16–27 6.95 inches
28–August 16 .38

Many trees have small flowering in early December.

1935

Rainfall December 30 (1934)–January 8 7.56 inches
January 9–13 .00

General small flowering, May 16.

The year 1935 was particularly interesting for two reasons. In the first place, the general flowering was a full month earlier than usual, following upon a most unexpected break in the wet season in the second week of December. In the second place, there was a quite well-marked second small flowering considerably more than a month after the first, and this corresponded to a second and more severe onset of dry weather, following much rain in the latter part of December and early January.

The above information needs to be supplemented by more detailed observations of the vegetative growth of Tembusu trees. What is required is regular measurement of the growth of all parts of a small branch, and also of the development of the inflorescence. It would be interesting also to make careful record of subsidiary flowering on a few individual branches, to find the minimum interval between two flowerings on the same twig.

It is quite likely that some other trees respond to the change of season in a similar manner to the Tembusu; but the only records I possess are of a much less regular nature. *Fagræa auriculata,* for example, sometimes flowers with the Tembusu and sometimes a full month later. The common scorpion orchid, *Arachnis flos-æris,* though flowering very regularly about May and November, does not appear to follow the fluctuations of the Tembusu. *Saraca taipingensis* and *Cinnamomum iners,* both of which flower gregariously not long after the change of season, are evidently more rapid in their response, and probably do not react to quite the same stimulus as the Tembusu, for I can find no relation between their flowering dates. Possibly some of the common species of *Eugenia* and *Elæocarpus* may have a similar response, but insufficient records of these are available.

Summary.

In Singapore there is an almost regular general heavy flowering of trees of *Fagræa fragrans* Roxb. in May. This flowering is shown to follow about four months after the break in the wet season which usually occurs some time in January. Observations of rainfall for ten days before the break in the weather, and for a week or more afterwards, are given; the fluctuations of date of this break are followed closely by fluctuations in the date of the general flowering of Cyrtophyllum trees.

THE SEASONAL FRUITING OF AGARICS IN MALAYA.

By E. J. H. Corner,

Singapore Botanic Gardens.

There is no day in Malaya when the fruit-body of some agaric cannot be found in the high forest, but twice each year, in the south at least, there is a season of three months when a "run of fungus" develops like the autumn crop in temperate countries. Fruit-bodies, never seen at other times, then appear in great numbers with a succession of early, mid- and late seasonal forms. The forest may be so full of toadstools of all sizes, shapes and colours, in troops on the ground and on fallen wood and in myriads on dead leaves and sticks, that one cannot step without treading on them, and each kind has its season of but a few days or a week when it is in full fruit.

I learnt of these seasons first in the Gardens Jungle, over the few acres of which I searched almost daily in the year 1929, and then from repeated collecting in the forests of Singapore and south Johore and from occasional visits to more distant parts of the country. In the Gardens Jungle, also, I set myself to discover the exact times of inception of fruit-bodies and their periods of development and maturity so that I could determine the life of different kinds of fruit-body and the climatic stimulus to which their mycelia responded. I have collected much information on nearly a hundred species but only a few general facts can be mentioned in this place.

The Seasons.

In Singapore the first toadstool-season of the year extends from March to May and the second, less regularly, from some time in August or September, rarely October, to October or the beginning of December. From 1929 till the beginning of this year Boleti, for instance, fruited chiefly in March and August or September; *Hygrophorus firmus* B. and Br. fruited in April and October or November; *Amanita virginea* Mass. in May and November or the beginning of December. The lowlands of south Johore appear to have the same seasons though the dates may differ by two or three weeks through local variations in the weather. At Tembeling, in the centre of Pahang, a run of fungus was in mid-course at the beginning of November 1930, and one had just ended at the beginning of June 1931. On Fraser's Hill, at 4000′ in Pahang, a run had just ended in the middle of November 1930 and 1932. About 20 miles inland from Chukai, Kemaman, there was no run of fungus at the end of June 1932, though the forest was very wet. In Penang a run was starting at the beginning of March 1929. These dates agree with the seasons in Singapore. But in Perlis, in the north, a run was starting at the end of November 1929: at Slim River, Perak, and

on Fraser's Hill, Pahang, a run was starting at the beginning of May 1930: round Kuala Pilah and on the lower slopes of Gunong Angsi, in Negri Sembilan, a run was starting in the last week of June 1930: at Cameron Highlands, at 5000′ in Pahang, a run was finishing at the beginning of August 1934. These dates disagree, yet one may be certain that, while there is a seasonal fruiting in all parts of Malaya following changes in the weather, the date of the season in each place depends on local conditions, for the times of the weather-changes vary considerably not only in the lowlands but from mountain to mountain.

The Succession.

Without a systematic account of malayan agarics, only an outline of the seasonal succession can be given. Briefly it has this order:—

1st Crop:—epiphyllous species of Marasmius, Androsaceus, Mycena, Collybia, etc. with small fruit-bodies: some horse-hair Marasmius: Coprinus, Psathyrella and Leucocoprinus.

2nd Crop:—developing 4–8 days after the first: most kinds with large fruit-bodies but especially Amanita, Amanitopsis, Lepiota, *Collybia radicata,* Laccaria, Lactarius, Russula, Volvaria, Pluteus, Clitopilus, Leptonia, Inocybe, Astrosporina, Cortinarius, *Hypholoma janus* (B. and Br.) Petch, *Psathyra trechispora* Petch, Psaliota, Boletus, *Paxillus, Lentinus giganteus* B.

3rd Crop:—about two weeks after the second: Hygrophorus, Cantharellus, Pleurotus, Entoloma, *Clitopilus flavidus* Mass. (really an Entoloma), *Lentinus connatus, L. blepharodes, L. hookerianus, L. similis,* and other horse-hair Marasmius.

4th Crop:—about two weeks after the third: *Hygrophorus firmus* B. and Br. and several miscellaneous species.

5th Crop:—about 2–4 weeks after the fourth: *Amanita virginea* Mass. and many species of Hygrophorus and Marasmius.

The crops are not actually distinct but peaks, rather, on a summation curve in which the number of species fruiting in a locality and the number of fruit-bodies would be plotted against time, and with fewer, less conspicuous species fruiting in the intervals. The succession is so constant under normal conditions that a few easily recognisable species serve as indicators:—

Crop.		*Indicator.*
1st	...	Epiphyllous Androsaceus and Filoboletus (=Poromycena)
2nd	...	Amanita, Russula, Boletus in great variety
3rd	...	*Clitopilus flavidus* Mass.
4th	...	*Hygrophorus firmus* B. and Br.
5th	...	*Amanita virginea* Mass.

Amanita virginea, like *Collybia velutipes* in England, signifies the end of the season.

The Cause of the Seasons.

In most of Malaya rain falls so frequently that the forest is nearly always damp. A week without rain scarcely affects the humus. But twice each year, after the wet weather of November and December and April to June or July, there comes a spell of several weeks with sunny, windy days and only occasional showers. The forest then dries; the humus becomes friable and brittle; streams shrink in their beds; and the leeches disappear. Mycelial growth in the soil gradually stops and the hyphæ remain dormant for a week or more. At the next rains the hyphæ revive and fruit. Thus spring the first two crops of toadstools which begin the succession.

It may be thought, now, especially from the evidence of fungi grown in culture, that a mycelium would fruit so soon as it had gathered enough food, but I am convinced direct fruiting is exceptional among forest fungi and pertains more to species of transient or confined habitats, like coprophytes and carbonicolous forms. This succession in the rain-forest shows that most forest-species need an external stimulus to fruit, which is primarily the check to vegetative growth given by mild drought. For, two or three days after the forest floor is soaked again, fine rhizomorphs begin to grow in the humus and there is the mouldy smell of active mycelium. A few days later the primordia of Russules, Boleti and Amanitas appear and these, I find, take only 8–10 days to mature. There is, therefore, no time between the onset of the rain and the fruiting for vegetative growth. Indeed, the first mycelial growths of these fungi after the soaking of the soil are slender rhizomorphs—somatic strands, not diffuse feeding hyphæ.

The relation between the dry weather, the onset of the rain and the crops of Boleti in the Gardens Jungle is shown in the following table. The period of the dry weather is taken from the daily rainfall record in the Botanic Gardens and measured from the end of continually wet weather to the heavy rain which caused the resumption of mycelial growth in the soil. Actually it is an interrupted period of dry rather than wet weather, and single storms and light rain on a few successive days I have reckoned in the dry weather because I found, by carefully digging in the humus where toadstools always grew, that such rain never penetrated or lasted long enough to evoke the development of primordia. By digging in the humus after each likely storm toward the end of the dry weather, I determined to a few days when mycelial growth was resumed.

Year	*Dry Weather*	*Rain begins*	*Mature Boletus-crop*
1929	7th Jan.–8th March	9th March	24th March
	29th June–23rd Aug.	24th Aug.	10th Sept.
1930	20th Jan.–6th March	7th March	22nd March
	23rd June–6th Sept.	6–14th Sept.	24th Sept.
	15–27th Sept.	28th Sept.	16th Oct.
1931	26th Jan.–28th Feb.	1st March	18th March
	10th June–18th July	19th July	7th Aug.
1932	1st –18th Jan.	19–26th Jan.	8th Feb. (small fruiting)
	27th Jan.–16th Feb.	17th Feb.	6th March (heavy fruiting)
	10th July–2nd Sept.	3rd Sept.	20th Sept.
1933	26th Jan.–23rd Feb.	24th Feb.	14th March
	No record in second half of year		
1934	20th Jan.–27th Feb.	28th Feb.	20th March
	4th Sept.–8th Oct.	9th Oct.	27th Oct.
1935	6–25th Dec. 1934	26th Dec. 1934 –21st Jan.	20th Jan.
	22nd Jan.–12th Feb.	13th Feb.	6th March
	9th July–9th Aug.	10th Aug.	31st Aug.

Two crops of toadstools immediately follow the rain because the fruit-bodies of the epiphyllous species of the first crop are small and develop more quickly than the larger ones of the second and, moreover, growing on the surface of the humus, their mycelia revive sooner than the more deeply situated and, perhaps, mycorhizal mycelia of the second crop.

The toadstools of the third crop, which mature about 4–5 weeks after the wet weather has returned, may need to vegetate before fruiting or they may be delayed merely because their mycelia recover more slowly or take longer to develop rhizomorphs than those of the early crops: in general, their primordia develop at the same rate as those of Boleti. The toadstools of the fourth and fifth crops must have a preliminary vegetative stage yet they do not fruit indiscriminately as shown by their constant sequence.

Heavy rain must follow the dry weather to revive the mycelia but rain in itself is no stimulus to fruit. In June and December, when the forest is wettest and mycelia have been growing during several months of rainy weather, fruit-bodies are scarce. Toadstools of the second crop, which fruit about August, do not fruit in December though they have been vegetating for four months.

Many epiphytic orchids, it is well known, flower after a heavy storm not because of the wetting but because of the sudden drop in temperature during the storm. There is no evidence, however, that agarics respond to this stimulus. The drop in temperature must be appreciably less, both in degree and severity, in the humus than on the boughs of trees and, were the stimulus effective, runs of toadstools would be as frequent as the flowering of pigeon-orchids (*Dendrobium crumenatum*). I have, moreover, grown lignicolous agarics in a cool frame, where the temperature varied very gradually from 73–78° F. daily, and found that by drying the logs for two weeks and then soaking them fruit-bodies would develop without any marked change in temperature. And it seems that, except the highest mountain tops, nowhere in Malaya is the temperature low enough to limit the fruiting or the distribution of toadstools. All the common lowland species occur in the mountains at 4000–5000′, where the soil-temperature in the forest is, on the average 60–70° F. and 10–15° below that in the plains.

Some of these agarics, especially the Russules, Boleti and Amanitas, must be mycorhizal. In forests which I have repeatedly visited they occur season after season in the same places under the same trees, among which dipterocarps, oaks and Castanopsis are prevalent, and not elsewhere. They should fruit, one might imagine, according to some general activity of their host yet, as they do so at the same time or in sequence with saprophytic species, their mycelia must react like the saprophytic. Most forest trees respond to one or both dry spells of the year by flowering or leafing so that a run of fungus coincides with a flowering season, but without exact knowledge of the habits of the trees or of their mycorhizal fungi the ways of the two cannot be related. A remarkable Russule, for instance, I found in fruit in the mid-weeks of April and October in 1930, 1931 and 1932 only in one small area, about 30 yards across, on the lower slopes of Gunong Panti in Johore; it is clearly a seasonal, mycorhizal species, but its host cannot be determined by inspection for some twenty kinds of tall tree grow in proximity.

The Shortness of each Season.

During a normal year in Singapore and, probably, in any one locality in Malaya, Boleti will fruit for two weeks, the first in March, the second about September, and a botanist visiting the forest at other times could have no inkling of their existence

apart from a few species which fruit sporadically. (I have collected about 60 species without particular search). So, too, with other forest agarics: their seasons are remarkably short. Unless one can visit the forest at least once a week during a run of fungi many species, if not an entire crop, may be missed not merely because each has its place in the succession but because the fruit-bodies develop rapidly, especially through the later stages of expansion when they emerge from the humus, and they are short-lived. Those of Boleti, Paxillus, Flammula, Inocybe and Hygrophorus last about 4–5 days at maturity; those of Entoloma, Cortinarius and Lentinus may last a week or ten days; those of Amanita, Lepiota, Collybia, Russula, Lactarius, Volvaria, Psaliota and Psathyra last only 2–3 days: though there are a few exceptions such as two Boleti which I find last nearly three weeks.

When Patouillard came to Singapore on August 21st 1917 (Journ. Straits Branch R.A. Soc. no. 78, p. 67), there was a Boletus season in the Gardens Jungle and he described sixteen new species, though only seven had not already been collected by Ridley and Burkill in the same place and described by Massee (Kew Bull. 1901, 1909, 1914). But it could never have befallen Westerdijk that he went into the forest during a toadstool-season, when he wrote of the malayan region "In the virgin woods.....even the flora of mushrooms on the ground .....is absent. Everything seems to point to the conclusion that conditions are unfavourable to fungus growth" (Ann. Miss. Bot. Gard. 1915, 2, 308).

Irregularities in the Seasons.

A run of toadstools in the forest in a sure sign of a climatic change. The weather must have been dry enough to have affected the humus and the ensuing rain heavy and prolonged enough to have soaked it. A dry week might stimulate trees to flower or change their leaves and a storm might cause the pigeon-orchid to flower but the effects of such would not penetrate the dense canopy of the forest. Nevertheless there are minor irregularites in the toadstool-crops, which appear to be caused more by topographical features than climatic. A small, isolated and deteriorated patch of forest, such as the Gardens Jungle or the Bukit Timah Forest Reserve in Singapore, is exposed and a short dry spell or single storm might affect the humus; the wind could blow through such forest and dry the soil in weather which would not affect the continuous virgin forest. Thus I have noticed that there may be two crops of Boleti at the beginning of a season. In the Gardens Jungle in 1930, after a dry July and August, a great many Boleti began to develop about the 16th Sept., following a rainstorm on the 6th with showery weather in the ensuing week. But from the 15–27th the weather turned dry and windy and the floor of the jungle soon dried out; most primordia shrivelled and only a very few

came to maturity. Rainy weather followed from the 27th, with a heavy storm on the 28th, and the normal run of fungi began in October with a second, rather feeble, crop of Boleti about 16th October. It is unlikely that the rain from the 6–14th September would have soaked the humus in virgin forest or, if sufficient, that the following dry spell would have checked the new growth of mycelia, and there would thus have been the one normal succession. For the same reason there were two crops of Boleti at the beginning of 1932 and 1935; and the first crop of 1935 was exceptionally early because the wet weather broke a month before usual. In each of these instances only the first two crops of the succession were repeated; presumably the dry weather which returned after the first heavy rain prevented the mycelia of species of the subsequent crops from reviving, and one might prefer therefore a late-seasonal species as *Hygrophorus firmus* to indicate the seasonal run. Similarly, the crop of epiphyllous agarics may occur out of order: in the Gardens Jungle there may be a small crop in June because the surface of the humus dries in a few windy days and a single heavy storm may penetrate the rather light canopy and soak it. But how often or at what short intervals of dormancy or vegetative growth the toadstools of the first two crops can be made to fruit under such circumstances I cannot state. Nor is it known how mycelia remain dormant in dry soil; few species have sclerotia.

Observations on crops of Boleti, as the most easily recognised indicators of a succession, would in the virgin mountain forest give a valuable clue to the climate. For instance, in the ridge-forest on Gunong Panti in S.E. Johore I have never seen a run of fungus though I have visited it in most months of the year and when there has been a run on the lower slopes: it is a long, narrow and disconnected mountain about 1600′ high and its climate, which must be intermediate between that of the East and West coasts, is generally wet.

Species in Secondary Habitats

The environmental factors controlling the growth of fungi are much more equable in the high forest than in the open or in secondary jungle, and the fruiting of agarics in such places may be irregular. All such places, in fact, as lawns, pastures, orchards, estates and other clearings, must be considered secondary habitats because the land was originally covered with high forest and malayan fungi are primarily forest dwellers. Agarics of secondary habitats fruit also in crops in response to the same stimulus as the forest species but, because of the openness of their habitat, their mycelial growth is checked more readily by short dry spells and promoted again by lighter and

less prolonged rain. Of this kind are several species of Hygrophorus related to *H. puniceus* and *H. conicus*, Lepiota, Marasmius, Clitopilus, Leptonia, Galera, Naucoria, Coprinus and Psaliota on lawns or pastures, and of Pleurotus and Pluteus together with *Schizophyllum commune*, *Collybia apalosarca*, *Flammula dilepis*, *Lentinus sajor-caju*, *L. subnudus*, and *L. Lecomtei* on logs in the open. They do not fruit continuously in wet weather nor will they fruit without an interval for vegetative growth after each crop. As already mentioned, I have proved this by growing several of the lignicolous kinds under equable conditions: no fruit-bodies grew when the logs were kept continuously damp during 3–6 months but, when they were dried for 10 days and then sprayed, an abundant crop was obtained. Indeed the best way to study lignicolous agarics is by collecting logs from the forest in the wettest weather, drying them gradually in a shady place for 10 days and then spraying them frequently: the variety of basidiomycetes which develop is often incredible.

The only agarics which I have found fruiting continuously under wet conditions are coprophilous ones, which grow and fruit till their habitat is exhausted, and some lignicolus species of Mycena, Collybia, Marasmius and Pleurotus with small fruit-bodies, yet even they respond to the stimulus of drying and wetting.

The Termite-Agaric, Collybia albuminosa (Berk.) Petch.

So irregular is the fruiting of this species that I can form no opinion about it. As Petch noted (A. R. B. Gdn. Perad. 1913, 5,323) it fruits from inhabited nests, but it seems not to fruit more than once from the same nest, at least in Singapore where, however, most nests are rather small, and so one cannot watch the same place repeatedly. It fruits at any time of the year, even in the dryest weather on lawns which are browning, and though there are many nests in the Gardens Jungle from which it could develop it gives no special crop in a seasonal run of toadstools.

The Fruiting of other Basidiomycetes.

It appears that all kinds of Basidiomycetes, fruit in Malaya according to their season exactly as the agarics, but I have few detailed observations on others. The rain which starts a run of agarics starts also the fruiting of the woody Thelephoraceæ, Hydnaceæ and Polyporaceæ, most of which become noticeable rather late in the succession because their fruit-bodies grow slowly, though a few, like Favolus and some Hydnums and Polypores, grow fast and come with the second crop of agarics. The dry weather

checks also the growth of the perennial fruit-bodies of Fomes, Stereum and Hymenochæte and they form a new layer of tubes or hymenium in the wet weather: hence, in a normal year, these fruit-bodies develop two layers of tubes or hymenium, unless they have grown in secondary habitats when they may develop more numerous and narrower layers. Even the resupinate fruit-bodies of Poria, Corticium and Odontia become stratified in this way.

Most Clavarias fruit with the second or third crop of agarics, but the coriaceous fruit-bodies of Lachnocladium generally develop later with the fourth crop. There are Clavarias, however, which fruit late in the season.

Lycoperdon, Calvatia, Scleroderma, Mitremyces and the subterranean forms, as Hymenogaster, Hydnangium, Leucogaster and Dendrogaster, fruit with the second or third crop of agarics: the fruit-bodies of some develop as rapidly as those of Amanita. The Nidulariaceae, Geasters and *Tylostoma exasperatum* fruit later with the fourth or fifth crops, but I have not been able to watch them. In the forest at Tembeling, in Pahang, during the second and third weeks of November 1930, there was a remarkable fruiting of some ten species of Geaster: the fruit-bodies developed mostly on the deep humus between the buttresses of tall trees and at the base of some the humus was almost covered: yet most of these I have not seen elsewhere in Malaya or, indeed, another such crop at any time. The season of the phalloids I do not know. Dictyophora, in the Botanic Gardens, fruits irregularly with the toadstools of the lawns: other kinds I have found too seldom to generalise.

Most Auriculariaceae, Tremellaceae and Caloceraceae fruit early in the succession, with the second and third crops of agarics, but there are some which fruit late.

Comparison with Temperate Countries.

Of the genera of agarics common to tropical Asia and the north temperate region, those are best represented in the tropics whose species fruit chiefly in the late summer or early autumn in the temperate region. Dry weather in May or June in England, followed by rain in June or July, will the cause the fruiting in July or August of many species of the following genera:— Amanita, Amanitopsis, Lepiota, Hygrophorus, Laccaria, Russula, Lactarius, Marasmius, Cantharellus, Clitopilus, Leptonia, Entoloma, Pluteus, Inocybe, Astrosporina, Psaliota, Hypholoma (sect. *H. appendiculatum*), Psathyra. Boletus and Paxillus. And these genera are well represented in Malaya, there being, for instance, several species related to *Amanita caesarea* of southern Europe, and malayan toadstools in general resemble

those of the southern United States. In contrast, Tricholoma, Clitocybe, Collybia, Pholiota, Cortinarius, Hebeloma, Naucoria, Tubaria, Flammula, Stropharia, Hypholoma (sect. *H. fasciculare*), Gomphidius, Psilocybe and Panaeolus, whose species fruit mostly in late autumn and early winter in Europe, are poorly represented. I have not seen a single specimen of Tubaria or Gomphidius in Malaya———(*G. roseus* Mass. non (Fr.) Quel., described from Singapore, is probably *Paxillus lateritius* Petch and, certainy, no Gomphidius)———and only one Phlegmacium, one Hebeloma and one Psilocybe. Gomphidius, however, is typically associated with forests of Abietineæ and these are absent from Malaya.

It seems that the agarics of temperate countries can be divided roughly into two groups:—1. those which are related to tropical species and which fruit, like them, at relatively high temperatures in response to summer drought followed by late summer rain; 2. those which are truly temperate and fruit at relatively low temperatures in late autumn, winter or spring and perhaps only after night-frosts or prolonged cold rain.

Summary.

Each normal year agarics have two general fruiting seasons in south Malaya, perhaps over the whole country. A succession of species then develops for some three months. Each has its own short season of about a week in full fruit and most, especially Amanita, Russula and Boletus, fruit at the beginning of the succession.

The first season beings in March, the second about August or September. Both follow immediately the change from dry to wet weather. The stimulus to fruit is primarily the dry weather which checks mycelial growth, and ensuing rain causes the development of fruit-bodies. Seasonal species do not fruit in prolonged wet weather.

Observations on crops of Boleti in the forest would give valuable evidence of the local climate.

Agarics in open places fruit more often because their habitat is more exposed to alternate drying and wetting.

Most other basidiomycetes fruit in the same seasons. Perennial fruit-bodies normally develop two new layers each year.

Malayan agarics in their kind and manner of fruiting resemble the summer and early autumn agarics of temperate lands.

A FEW ORCHIDS FROM THE MALAYAN ARCHIPELAGO.

By J. J. Smith,

Oegstgeest, Holland.

Oberonia (sect. Hymenobractea, incl. Platystreptus) **Latifii** J. J. S. np.

Caules approximati, elongati, compressi, serpentini, cum alis vaginarum recti, 12-21 cm. longi, cum vaginis c. 1.2 cm. lati, 10-21-folii. Folia inarticulata, erecto-patentia, plerumque plus minusve falcatula, basin versus decrescentia, summa etiam minora, breviter acuta vel brevissime acute acuminata, parte patente elongato-triangula, basi haud vel vix fissa, 2.1-3.3 cm. longa, 0.6-0.8 cm. lata, cum vagina 4.2-4.6 cm. longa, vaginis sensim in folia vergentia, 0.75-0.8 cm. latis antice fissis, basi tantum tubulosis. Inflorescentia elongata laxe multiflora, c. 20-22 cm. longa, angulata, papillosa. Bracteæ oblongæ, versus apicem angustatæ, irregulariter eroso-fimbriato denticulatæ, concavæ, c. 0.225 cm. longæ, fere 0.1 cm. latæ. Flores in pseudoverticillis 5-6-meris, in inflorescentiæ apice basique irregulariter dispositi, patentissimi vel subpatentissimi, parvi, c. 0.2 cm. diam., sepalis petalisque patentissimis, apice leviter recurvulis. Sepalum dorsale ovatum, obtusum, convexum, basi concavum, bene 0.1 cm. longum, 0.06 cm. latum. Sepala lateralia ovata, acutiuscula, convexa, bene 0.1 cm. longa, 0.07 cm. lata. Petala divaricata, leviter recurvula, oblonga, obtusa, basi paululum angustata, convexa, margine papillosa, fere 0.1 cm. longa, 0.04 cm. lata. Labellum basi auriculis oblique rotundatis gynostemium semiamplectens, concavitate antice rotundata ad basin, 3-nervium, antice in lobum medium cum auriculis angulos rotundato-obtusos facientem ambitu quadrangulum apice leviter angustatum angulato-retusumque margine papillosum contractum, expansum 0.1 cm longum, ad auriculas fere 0.1 cm. latum, lobo intermedio 0.06-0.07 cm. longo, 0.05 cm. lato. Gynostemium breve, rectum, a dorso compressum, dorso convexum, cum anthera 0.04 cm. longum. Anthera cucullata, transverse ovalis. Pollinia 4, in corpuscula 2 ovalia plus minusve obovata unita. Stigma transversum, semilunatum. Ovarium densius patentissime papillosum, 0.06 cm. longum; pedicellus minus dense papillosum, 0.16 cm. longum.

Sumatra:—West Coast, environs of Kajoe Tanam, 150 m. (S. M. Latif n. 13, November, 1934).

This belongs to the group of species on which Schlechter based his sections *Hymenobractea* and *Platystreptus*. In habit it approaches *Hymenobractea*, in the shape of the flowers *Platystreptus*, but it is questionable whether these groups, even when united, may be retained as a section.

O. Latifii is a near ally of *O. monstruosa* Lndl. but the leaves are much more numerous and denser and the lip much less contracted.

Description from herbarium specimen, for which I am indebted to Mr. Latif.

Dendrobium (sect. Calcarifera) **Paathii** J. J. S. in "De Orchidee" IV (1935) 183.

Caules elongati, deinde ramosi. Inflorescentiæ e nodis caulium defoliatorum, ut videtur semper unifloræ, pedunculo tenui c. 1.3 cm. longo. Bractea adpressa, triangula, c. 0.26 cm. longa. Flores conspicui c. 4.4 cm. longi, 2.75 cm. lati. Sepalum dorsale erectum, recurvulum, convexum, oblongo-ovatum, apice angustatum, obtusum, 1-nervium cum nervis minoribus intermixtis, c. 1.85 cm. longum, 1 cm. latum. Sepala lateralia lacinia conspicua oblique lineari-oblonga concava ad pedem gynostemii decurrentia, marginibus anticis versus pedis apicem contigua longitudine c. 0.45 cm. connata, mentum magnum calcariforme cum ovario angulum acutum vel subrectum faciente fere rectum ultra medium leviter recurvulum apice abrupte incurvum truncato-obtusum antice canaliculatum apice antice bilobulum 2.4 cm. longum apice 0.525 cm.latum formantia, parte libera recurva, oblique ovato-triangula, obtusa, marginibus leviter curvatis, c. 8-nervia, c. 1.95 cm. longa, margine antico 3.65 cm., basi 2.5 cm. metientia. Petala apice recurva, laxe undulata, oblique rhombea, obtusa 3-nervia, nervis exterioribus bene ramosis, bene 2 cm. longa, 1.15 cm., basi 0.33 cm. lata. Labellum basi longitudine c. 0.6 cm. pedi gynostemii adnatum, deinde arcuato-recurvum et incurvum, subparallelum pedi gynostemii erectum unguiculatum, cuneato-spathulatum, 3-lobum, lobis lateralibus erectis concavum, leviter undulatum, gynostemium superans, subtus tota longitudine sulcatum, ungue ad basin partis liberæ incrassatione transversa carnosa margines unguis connectente postice in crura 2 basin versus producto antice fimbriato instructo, costa brevi longitudinali (glandula) inter crura, intus ante incrassationem ad basin laminæ verruculosum, 3-costatum, costis approximatis angustis convexis simplicibus, costa media basin lobi intermedii usque producta, lateralibus humilioribus brevioribusque inexplanatum 3.85 cm. longum, explanatum fere 4 cm. longum, ad lobos laterales 2 cm. latum, ungue toto c. 1.2 cm. parte connata 0.8 cm. longo; lobi laterales expansi sinibus subrectangulis plicaque introrsa a lobo intermedio separati, oblique trianguli, obtusi, margine antico leviter rotundati, costula inconspicua intus marginem lateralem mesochylium cuneatum antice truncatum infra apicem satis distincte contractum 2.1 cm. longum apice 2 cm. infra apicem 1.6 cm. latum formantes lobus intermedius erectus, leviter sigmoideus angulato-convexus, anguste triangulo-oblongus, obtusus, basi margine minute transverse rugulosus, carnosulus c. 1.1 cm. longus, basi 0.6 cm., medio 0.73 cm. latus. Gynostemium breve, oblique conicum, dorso convexum, absque anthera 0.5 cm. longum, clinandrio excavato, transverse quadrangulo, filamento satis longo, vix curvulo lineari, auriculis porrectis, verticalibus, filamento æquilongis, ovato-triangulis, breviter acuminatis, acutis vel obtusis. Anthera

cucullata, oblique cubica, dorso transverse gibbosa, postice canaliculata, apice producta truncata papilloso-hirtella, c. 0.4 cm. longa, 0.3 cm. lata. Pollinia 4, lateraliter compressa anguste obovato-pyriformia, 0.3 cm. longa. Rostellum appendice semor biculari margine incrassato (viscido?) basin stigmatis obtegente instructum. Stigma conspicuum, basin gynostemii fere attingens oblongo-quinquangulare circiter dimidio inferiore contractum. Pes gynostemii cum ovario angulum acutum vel subrectum faciens elongatus leviter sigmoideus, apice bene incurvus et ungui labelli adnatus, linearis canaliculatus apice incurvo magis excavatus et glandula costiformi longitudinali donatus 2.45 cm. longus. Ovarium teres 6-sulcatum, 0.9 cm. longum, cum pedicello tereti leviter sigmoideum.

Borneo:—Westerafdeeling, Goenoeng Raja near Singkawang. (J. J. Paath, April, 1935; "sepals and petals white, lip yellow, streaked orange in the throat, midlobe white").

A very distinct member of the section *Calcarifera* of which I do not know a very near ally.

Description from 2 flowers preserved in alcohol.

Dendrobium (sect. Distichophyllum) **singkawangense** J. J. S. n. sp.

Caules approximati, c. 20 cm. longi, flexuosi internodus c. 1.7 cm. longis. Folia patentissima, apice recurvula, oblonga, apice oblique rotundato-bilobula, ut videtur initio nigro-pilosa, costa media supra sulcata subtus prominente, c. 4.3 cm. longa, 2.3-3.3 cm. lata; vaginis internodia æquantibus.

Inflorescentiæ vaginam dorso ad basin perforantes, brevissimæ, 3-4-floræ, rachide nonnullis pilis adpressis partim ramosis nigris inspersa c. 1-2 cm. longa. Bracteæ oblongæ acutiusculæ, concavæ, dorso et etiam intus ad apicem marginemque pilis 1-3-ramulosis grossiusculis nigris vestitæ, c. 8-nerviæ nervis 3 mediansi usque ad apicem productis membranaceæ 1.175 cm. longæ, 0.475 cm. latæ. Flores carnosuli, c. 2.9 cm. lati, 2.8 cm. longi. Sepalum dorsale cum ovario angulum obtusum faciens, levissime sigmoideum porrectum, secundum costam mediam canaliculatum subovatum, apice triangulo-contracto-acuminatum, satis acutum, margine superne subirregulare basi latum 7-nervium, c. 1.6 cm. longum, fere 0.8 cm. latum. Sepala lateralia cum pede gynostemii mentum conicum rectum cum ovario angulum acutum faciens dorso longitudinaliter bicanaliculatum basi utrinque gibbiforme parte superiore calcariformi-contractum cum marginibus anticis fere omnino liberis contiguisque obtusum 1 cm. longum formantia divergentia angulum acutum facientia, secundum costam leviter canaliculata obtusangule triangula, acuta breviter apiculata, apice subirregulariter marginata, dorso obtuse carinata, 7-nervia c. 1.75 cm. longa, margine antico 2.5 cm. basi 1.35 cm. metientia. Petala divergentia, apice recurvula oblique ovata, 2/5 partibus superioribus triangulo-contracto-acuminata acuta, basi utrinque rotundata medio tantum

affixa, 3-nervia, nervis exterioribus ramosis, textura sepalis tenuiora, 1.75 cm. longa, 1.05 cm. lata. Labellum ungue parti superiori pedis gynostemii calcariformi-connatum, 3-lobum, concavum, lobis lateralibus gynostemium æquans, subtus inter lobos laterales leviter longitudinaliter canaliculata, intus inter lobos laterales incrassatione longitudinali leviter 3-costulata in lobo intermedio in costas 3 valde verruculosas apicem labellifere attingentes exeunte, 5-nervium, nervis lateralibus valde ramosis nervis ramisque omnibus in lobo intermedio valde verruculosis ceterum serie unica verrucularum instructis, inter nervos in lobo intermedio humilius verruculosum, in basi laminæ fascia longitudinali glabra excepta papillosum, expansum totum ambitu, rhombeum, fere 2.5 cm. longum, 1.5 cm. latum, ungue oblongo, longitudine 0.6 cm. pedi gynostemii adnatum; lobi laterales erecti, rotundato-trapezoidei, antice vix producti margine antico leviter irregulares, mesochylium æquilateraliter trapeziiforme c. 1.1 cm. longum formantes; lobus intermedius cum lateralibus angulos acutos faciens, porrectus, recurvus, undulatus, irregulariter marginatus, expansus quinquangularis, apice angustatus, obtusiusculus, 0.9 cm. longues, 0.75 cm., basi 0.575 cm. latus. Gynostemium rectum subconicum dorso convexum, subtus planum, cum anthera 0.525 cm. longum, filamento longo, filiformi-subulato, auriculas paululum superante, auriculis triangulis, acutiusculis margine postico leviter serrulatis concavis. Anthera cucullata antice visa quinquangularis, dorso obtusa retusaque, apice in appendicem transversam subtruncatam vix retusam dense hirtellam producta, omnino minute cellulosa, 0.25 cm. lata. Pollinia 4 in corpuscula 2 unita lateraliter compressa, oblique oblonga vix curvula, 0.175 cm. longa. Stigma basin gynostemii attingens, oblongo-ovale, vix urceolatum, basi rotundatum apice truncatum. Pes gynostemii cum ovario angulum acutum faciens, rectus, canaliculatus, fere dimidio superiore labelli ungui adnatus et angustior, parte lata dorso conspicue bicanaliculatus, 1 cm. longus. Ovarium oblique obconicum, 6-sulcatum, cum pedicello angulum obtusum faciens, 0.65 cm. longum; pedicellus teres c. 2.5 cm. longus.

Borneo:—Wester Afdeeling, Singawang, alang-field with scattered trees, epiphytical (F. J. Paath, 20 October, 1934; "flowers creamy white, midlobe of the lip inside bright orange").

A distinct species of the group *Nigrohirsuto* of the section *Distichophyllum*. The lip is very warty inside, as in *D. ovipostoriferum* J. J. S., *D. Hallieri* J. J. S. etc., but it is very different from any of the species known to me in the rather short mentum, in the side lobes, which are very large as compared with the midlobe, and in other characters. In the shape of the ovate acute petals it somewhat resembles *D. Hallieri*.

By the good offices of the editor of "De Orchidee" I received flowers preserved in spirit and photographs from which the description has been made.

THE EPIPHYTIC FLORA OF DIPTEROCARPUS OBLONGIFOLIUS, Bl. ("Neram").

By M. R. Henderson,

Botanic Gardens, Singapore.

Dipterocarpus oblongifolius, Bl. is a common tree on the banks of rivers and streams, especially east of the Main Range of the Malay Peninsula, and is abundant on some of the tributaries of the Pahang river. It appears to be confined to riverbanks, and is a massive tree, though not usually tall as compared with other Dipterocarps.

Its ability to grow on steep banks and its resistance to floods are remarkable. This is probably due in part to its root system. Judging from specimens seen which had their roots exposed by floods, the roots do not penetrate deeply into the soil but spread over a large area and are so tenacious that the whole top of a tree may be wrenched off by pressure of floodwater and drift-wood, leaving the roots and lower part of the trunk undisturbed.

Where the trees grow on steep banks, the base of the trunk is almost at right angles to the bank. The more nearly perpendicular the bank the more nearly horizontal the base of the trunk, which then curves gradually upwards but seldom attains a perpendicular position. The same method of growth may be observed in such plants as *Pandanus* growing on very steep limestone cliffs. The upper surface of the basal portion of the trunk of the *neram* is extended into a flange, so that a cross section of the trunk at this point would be roughly a triangle with a rounded base, or somewhat pearshaped. This extension of the trunk no doubt acts as a stay, and the tree is actually not buttressed in any way, as there is no buttress development on the lower surface of the trunk, and less development of roots in the direction of the water than in other directions.

In some localities the *neram* trees carry a large and varied epiphytic flora, which is more easily examined than that on tall forest trees, as the former are usually not difficult to climb and can be examined from the streambed with comparative ease. A census of this epiphytic flora was attempted during an expedition to one of the small tributaries of the Tembeling river (Sungai Sat) in July, 1929 and to Sungai Ketil, Kelantan in the following month. It is noticeable that on the banks of the larger rivers, such as the Tembeling in Pahang and the Lebir in Kelantan, where the original vegetation has been cleared, the *neram* trees, where they have been allowed to remain, carry few epiphytes, but on the smaller rivers, where the original vegetation has not been destroyed, and where the trees meet overhead, epiphytes are much more numerous. The luxuriance of the epiphytic flora,

however, varies in a curious way. For instance, the trees along the Sungai Terang, a small tributary of the Lebir, carried few epiphytes compared with those on the Sungai Sat, although one would have said that the conditions were more favourable on the former river. The same applies to the epiphytic flora of *Saraca*. In some places these trees are loaded with small orchids, while in other apparently similar localities they bear none.

It was found that the orchids were the most numerous and for this reason they were given more attention than other groups. For the identification of these I am indebted to Mr. C. E. Carr, whose detailed knowledge of the local orchid flora enabled him to identify most of the specimens although they were not flowering.

The method adopted was to send one or two men up the tree with instructions to strip off and throw down every epiphyte they could see. Branches were cut off and examined for such small plants as *Taeniophyllum*, and field glasses were used to ensure that nothing was missed. As far as possible identifications were made on the spot, and anything which could not be dealt with in this manner was preserved for future study. Probably about 10—20 per cent. of the total area of each tree was examined, the search being naturally restricted to the trunk and lower, stouter branches. Without felling the tree the canopy could not be examined. Many *Taeniophylla* are often confined to one or two branches and do not spread over the whole tree, and some species such as *Thrixspermum* grow amongst the leaves towards the tips of the branches in more or less full sunlight. However, the proportion of the epiphytic flora enumerated here is considerably more than 20 per cent. of the total, as the bulk of the epiphytes grow on the trunk and lower branches.

It was found impossible to make a count of individual plants. Some orchids and such ferns as *Drynaria quercifolia* were exceedingly abundant on some trees.

The following are the flowering plants (excluding orchids) and ferns :—

Vitis macrostachya, Miq.; Vitis sp.; Pachycentria tuberculata, Korth.; Medinilla Hasseltii, Bl.; Medinilla sp.; Schefflera Ridleyi, Vig.; Myrmecodia tuberosa, Jack; Hydnophytum formicarium, Jack; Vaccinium acuminatissimum, Miq.; Rhododendron Teysmanni, Miq.; Hoya latifolia, Don; Hoya sp.; Fagraea auriculata, Jack; Aeschynanthus radicans, Jack; Helixanthera coccinea, Dans.; Ficus consociata, Bl.; Ficus diversifolia, Bl. var. Kunstleri; Ficus diversifolia, Bl. var. ovoidea; Ficus parietalis, Bl.; Pothos sp.; ?Anadendrum sp.; Asplenium pellucidum, Lam.; Asplenium spathulinum, J. Sm.; Cyclophorus varius, Gaud.; Drynaria quercifolia, L.; Humata angustata, J. Sm.; Humata heterophylla, Desv.; Platycerium Ridleyi, Christ.; Polypodium lomarioides, Kze;

Polypodium mettenianum, Ces.; Polypodium phymatodes, L.; Polypodium revolutum, C. Chr.; Polypodium sinuosum, Wall.; Trichomanes minutum, Bl.; Trichomanes pallidum, Bl.; Vittaria elongata, Sw.; Vittaria ?ensiformis, Sw.; Lycopodium laxum, Spr.; Lycopodium nummularifolium, Lycopodium phlegmaria, L.; Lycopodium phyllanthum, H. & A. .

Six trees were examined particularly for orchids and the results are given in tabulated form below. The first three trees were in a group together, numbers four and five were together some distance upstream, and number six was on another small stream about a mile distant from the others.

——	1	2	3	4	5	6
Oberonia anceps, Lindl.			x			
Hippeophyllum Scortechinii, Schltr. ...			x			
Platyclinis longifolia, Hemsl. ...			x		x	
Dendrobium acerosum, Lindl. ...	x				x	
,, atropurpureum, Miq. ...			x			
,, bifarium, Lindl. ...		x				
,, eulophotum Lindl. ...	x				x	
,, Farmeri, Paxt. Mag. ...		x	x	x		
,, fugax, Schltr. ...		x	x			x
,, grande, Hook. f. ...					x	
,, Hosei, Ridl.				x	x	
,, indragiriense, Schltr. ...					x	
,, leonis, Rchb.				x		x
,, lonchophyllum, Hook. f.					x	
,, pensile, Ridl.	x	x	x	x	x	
,, pumilum, Roxb. ...	x			x	x	x
,, serra, Lindl.			x		x	
,, teres, Lindl.	x					
Bulbophyllum odoratum, Lindl. ...					x	x
,, lepidum, J.J.S. ...	x	x		x		x
,, medusae, Rchb. f. ...					x	x
,, purpurascens, Teysm. ...				x	x	x
,, restrepia, Ridl. ...	x					
,, vaginatum, Rchb. f. ...	x	x				x
Eria floribunda, Lindl.	x	x		x	x	
,, neglecta, Ridl.				x		x
,, suaveolens, Ridl.	x	x		x	x	
,, xanthocheila, Ridl.		x				x
Trichotosia Teysmanni, Kranzl. ...		x				x
,, velutina, Kranzl. ...	x					
Tylostylis rigida, Bl.			x			
Coelogyne Rochusseni, De Vr. ...	x		x	x		
,, testacea, Lindl. ...			x			
Cymbidium pubescens, Lindl. ...	x	x				x
Grammatophyllum speciosum, Bl. ...				x		
Saccolabium Hendersonii, Carr ...					x	
,, undulatum, Ridl. ...			x			

——	1	2	3	4	5	6
Renanthera elongata, Lindl. ...	x					
Sarcanthus Scortechinii, Hook. f. ...		x				x
Pomatocalpa Kunstleri, J.J.S. ...		x				
Sarcochilus pusillus, Rchb. f. ...			x			
,, virescens, Ridl. ...			x			
Taeniophyllum obtusum, Bl. ...			x			x
Poaephyllum pauciflorum, Ridl. ...		x	x			x
Appendicula cornuta, Bl.		x				x
Podochilus tenuis, Lindl.						x
Agrostophyllum bicuspidatum, J.J.S. ...	x	x	x	x	x	x
,, Hasseltii, J.J.S. ...	x	x	x	x	x	x
Oxyanthera decurva, Hook. f. ...						x
Thrixspermum pardalis, Carr ...			x			
Number of species on each tree ...	16	17	19	14	18	20

There were also two Eria spp. of the section *Hymeneria,* and a Bulbophyllum of the section *Aphanobulbon,* unidentified. Fifty known species and three unidentified species were therefore found on these six trees. The two species occurring on all six trees were *Agrostophyllum bicuspidatum* and *A. Hasseltii.* The only species common to the three trees close together were *Agrostophyllum bicuspidatum, A. Hasseltii* and *Dendrobium pensile.*

The following orchids were found on other *neram* trees :—

Liparis lacerata, Ridl.
Dendrochilum sp.
Dendrobium aggregatum, Roxb.
,, crumenatum, Sw.
,, Haniffii, Ridl.
,, luxurians, Carr
,, salaccense, Lindl.
,, flavidulum, Hook. f.
Bulbophyllum abbrevilabium, Carr
,, clandestinum, Lindl.
,, tortuosum, Lindl.
Eria pendula, Ridl.
,, pannea, Lindl.
,, leiophylla, Lindl.
,, stellata, Lindl.
,, biflora, Griff.
Trichotosia vestita, Kranzl.
Chelistonele sp.

Coelogyne Kingii, Hook. f.
,, stenophylla, Ridl.
Cymbidium aloifolium, Sw.
Acriopsis javanica, Reinw.
,, sp.
Agrostophyllum majus, Hook. f.
Bromheadia alticola, Ridl.
,, rupestris, Ridl.
Dilochia Wallichii, Lindl.
Thrixspermum arachnites, Rchb. f.
,, rubrocallosum, Carr
Taeniophyllum pahangense, Carr
Sarcochilus biserratus, Ridl.
Ceratostylis pendula, Hook. f.
Sarcanthus halophilus, Ridl.

The total number of species of orchids found on *neram* within a limited area is thus eighty-seven.

As a contrast to the *neram* flora, two trees of *Saraca bijuga* were examined for orchids and their flora was found to consist mainly of the following :—

Dendrobium subflavidum, Ridl.
Bulbophyllum nigropurpureum, Carr
Chamaeanthus laciniatus, Carr
Saccolabium Hendersonii, Carr
,, undulatum, Ridl.
Sarcochilus caligaris, Ridl.
,, ciliatus, J.J.S.
,, incurvicalcar, J.J.S.
,, pusillus, Rchb. f.
,, siamensis, Carr
Pomatocalpa Kunstleri, J.J.S.
Thrixspermum arachnites, Rchb. f.
Taeniophyllum obtusum, Bl.
,, rugulosum, Carr
Appendicula pendula, Bl.

It will be noticed that none of the commonest orchids on *neram* occur on *Saraca, e.g.* Dendrobium pensile, D. pumilum, Bulbophyllum lepidum, Eria floribunda, E. suaveolens, Agrostophyllum Hasseltii, A. bicuspidatum, are absent. The orchid flora of *Saraca* consists mainly of small plants such as Saccolabium, Sarcochilus, Thrixspermum, Taeniophyllum, etc., and large plants, such as Grammatophyllum, Coelogyne, Cymbidium, etc. are conspicuous by their absence.

PHYLOGENY OF SINGLE FEATURES,

as illustrated by a remarkable new Sapotaceous tree from British Malaya (Madhuca Ridleyi, n. sp.).

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In older works concerning the field of phylogenetic taxonomy, families and genera were considered as more or less static entities. It was accepted that they wandered both through time and through space, and also that, as they developed, or in general changed by evolutional processes during that journey they helped to form that much-discussed, but ever-mysterious structure, the genealogical tree. Such expressions as: the genus A has probably given rise to the genus B, the genus C is to be derived from the genus D, the genera E and F have common ancestors with the genus G, etc., are characteristic of those days. Although dynamic in the sense of evolution, these taxonomic units were, in fact, static entities, as they were considered to travel and to change as units.

However, taxonomic ideas are not the same nowadays. Genetics arose and developed and, being in some way the branch of science, which covers the phylogeny of living species, greatly influenced the ideas of taxonomical and phytogenetical investigators. Instead of a static treelike structure as the old extreme, we got, as the extreme opposite concept, a sort of dynamic network, comparable with the creeping plasmodium of a slime-mould. No fixed units any more, only a series of ever-changing combinations of a constant number of genetical factors (HAYATA). Although few will agree with an extreme dynamic system like his, the remarkable ideas of this author are certainly both characteristic of, and, to some degree, also responsible for the change of our thoughts. At any rate, the former families, genera, etc., are considerably less solid, not only in a taxonomic, but especially in a phytogenetic sense. Feeling that the old tree is as unsatisfactory as the slime-mould plasmodium to serve as a symbol for our ideas concerning phylogenetical processes, we are nowadays trying to find some "golden mean". We do that, for instance, according to an old and approved recipe, by analysis of the material available; in other words, we are no longer examining the tree and the slime-mould as a whole, but we try to look for what parts they are made of: we study single features. The features, whether determined by a single genetical factor or by a group of such factors, certainly have more right to be called the true taxonomical-genetical units than the individuals. During my investigations on Malaysian Burseraceæ (**5, 6**) I became more and more convinced of the value of this phylogeny of features

("Merkmalsphylogenie"; ZIMMERMANN); next to this my attention was drawn to the idea that features could, alone or in combination with others (coupling of factors), travel, fairly independently, not only through time but also through space for long periods (Paleogeography of features as *e.g.* practised by LYMAN B. SMITH, **7**). It seems possible that a middle course between the tree and the slime-mould may be found by accepting that all combinations of factors (features) and all grades of strength or duration of a coupling may occur. Evolution would mean in that case: a certain, yet undiscovered, trend in the way in which features cling together or in which certain combinations succeed each other. Both hybridization (LOTSY) and mutations (HUGO DE VRIES) find their place in this concept.

As in all phylogenetic studies, paleobotanic data are of principal importance, but as these are too often wanting we have to look for what taxonomy (morphology) and geography (distribution) may teach (VON WETTSTEIN). A careful and critical study of these data may give us an idea of the possible phylogeny of what we call a taxonomic unit. We shall then see, I expect, that generalisation is not possible in the way we were used to; that every genus, etc., has to be investigated quite separately, and that conclusions of a general nature may only be relative to the fundamental laws of evolution. These considerations leave the way open to a process of the origin of genera and families, which I think has been taken into account only too little up to now, *viz.* through polyphyletic evolution.[1] On account of our present knowledge I prefer a phylogenetic symbol in the form of a network-structure, extremely minute and dynamic at every point representing the present, and extremely coarse and static, as viewed from these points, in the farthest past; we have to bear in mind, however, that this structure is no reality but just a human attempt to grasp a complicated problem.

At the time that I studied Malaysian Sapotaceæ (**1, 2, 3, 4**), these ideas had not yet evolved in my mind. However, having taken up these studies[2] again with the aid of some collaborators, I have come upon some facts which perfectly fit into the above considerations, and I am glad to mention here an example of the probable phylogeny of a single feature, illustrated by a new species of *Madhuca,* which I am very much pleased to dedicate to the nestor of Malayan and Malaysian[3] botanists, Mr. H. N. RIDLEY, on the occasion of his 80th birthday. I have named it *Madhuca Ridleyi*; a diagnosis and a picture of the species may be found at the end of the present paper.

1 I hope to report on a striking example concerning this before long.

2 Publication of a revision may be expected next year.

3 Malaya = Malacca = the Malay Peninsula (British Malaya), which in this paper is considered as forming phytogeographically a part of Malaysia: Malaysia = the Malay Archipelago; the word has, if I am not mistaken, been introduced by E. D. MERRILL.

As appears from may earlier papers (**1,** p. 11, 110–112), *Madhuca* is one of four genera (the others are *Payena, Ganua* and *Burckella*,), together forming the group of the *Palaquiinæ-Madhuceæ-Eumadhuceæ,* well characterized by the possession of two whorls of two sepals each.

Let me begin with some words as to what may be suggested regarding the phylogeny of these four genera. As we know nothing about fossil *Madhuceæ,* we have to look for what data recent representatives have to yield. First of all we have to state, that all of the four genera are very closely related, which is illustrated by the great trouble it took to find a means of subdivision, as all features are very irregularly distributed over the genera. Apparently the *Eumadhuceæ* form a group which is in a state of initial differentiation into four branches; a differentiation, nevertheless, distinct enough to claim different names for the branches.

Valuable data may now be expected in the present distribution of species and features.

Distribution of species. As appears from the accompanying table (Pl. 3) and the map (Pl. 4), the group is restricted to S. Eastern Asia (Western limit: Deccan Peninsula and Ceylon) and Polynesia (as far east as Fiji, Samoa and Tonga) with a very distinct centre of differentiation in Western Malaysia (British Malaya inclusive).

According to orthodox ideas of historical phytogeography, our table (Pl. 3) confirms some well-known facts, obvious also in many other plant families, *e.g.*

1. that the phytogeographic relations between British Malaya and the greater Sunda Islands (especially Sumatra and Borneo) are extraordinarily strong (cf. **2,** p. 384–385, table; and **3**);
2. that next to a line of dispersion from Malaya to Sumatra, a very important line is that from Malaya to Borneo and the Philippines (Palawan !);
3. the hypothesis that this region which in a former period is supposed to have formed one big land mass that split up in postglacial times, has been an important source and centre of dispersion of plant groups, the areas of which are now disjunct.

On account of these considerations I would suggest that the *Eumadhuceæ* have originated in that former land mass, the so-called Sunda-land. From this centre, the group has spread geographically, during its morphological differentiation, both in western direction (continent of Asia) and towards the East, and the isolation of the various islands then gave rise to endemic species (the Philippines—*Madhuca*—and also New Guinea—*Burckella*—have apparently acted as secondary regions of differentiation), while other species remained unchanged everywhere or perhaps evolved in the same way in different places.

Of the three genera *Madhuca, Payena* and *Ganua* (cf. Pl. 3, 4 and 5), *Madhuca* covers the largest area and contains the greatest number of species. The differentiation of these genera mutually is both geologically and morphologically very young; *Ganua* has apparently its centre in Borneo (3 endemic species) with offshoots to British Malaya, Sumatra and Palawan (non-endemics) and, curiously enough, one isolated species in the Moluccas;[1] *Payena,* with greater area than *Ganua,* and also with stronger differentiation, is geographically intermediate between *Madhuca* and *Ganua.* Morphologically *Ganua* is developing in the direction of a peculiar venation of the leaves, of imperfect septa in the ovary and of dry fruits. *Payena* is distinguished by a well-characterized venation and a tendency to form a voluminous endosperm and *Madhuca,* with which *Payena* is connected by many transitional species, shows, besides a type of venation of its own, a tendency to reduce the endosperm. *Burckella* is the only genus that is more distinct morphologically, but especially geographically. In contradistinction to the other genera it does not follow the age-and-area theory, as the number of its species is small and its area large. Yet I see no reason to accept a reduction of the area and to consider the species as relic-endemics, but a biphyletic origin seems to be possible. In its venation it reminds one of eastern *Ganua*-species as well as of a certain type of mostly western *Madhuca*-species (Sect. *Dasyaulus*). It must certainly be remarked that its venation much resembles the type of the two geographically nearest species: *Ganua Bœrlageana* and *Madhuca Burckiana.* It shows, furthermore, a tendency to form very big fruits.

These general indications led me to the assumption that *Madhuca* is the basal group in which the other genera are rooting. Further evidence for this supposition may be found in some features, intentionally left unmentioned thus far.

Distribution of features. The characteristics purposely not yet mentioned are the number of parts in the corolla, the androœceum and the gynæceum. According to what is generally accepted, high numbers may also in this group be considered as representing the more primitive state. In the *Eumadhuceæ* there are two tendencies to be noticed: one to fix the said numbers at P. 8, A. 16, G. 8, and the second (which is, by the way, an extremely general one) to reduce the G. number beyond 8. Now we see that *Madhuca* is the only genus in which all whorls show a great variation *viz.* P. 18–6 (–5?), A. 40–12, G. 21–6. In the other genera P. and A. are, to a much higher degree, fixed to 8 and 16 respectively; G., however, shows a further reduction as far down as 3. It is certainly a striking fact that the highest numbers in the last-named whorl occur in or near the geographical

1 This may be a case of convergence (polyphyletic origin of the genus).

centre of the group and that the lowest ones occur in the most remote parts of the area (*Burckella* in Polynesia and *Madhuca*, although not exclusively, in India and Ceylon).

Our new species, *Madhuca Ridleyi* is, in this respect, to be considered as a representative of a most primitive state, the numbers of parts in its P. and G. whorls being by far the highest known in the whole group, *viz.* P. 18, A. 37 – 36, G. 21 – 18 !

The following facts may elucidate this somewhat more in detail : —

Madhuca. P. 18–6 (–5?) A. 40–12 G. 21–6.

Between these extremes there is a very rich variation. Most species show a variability in all whorls, and often a considerable one, also those which cannot be said to be polymorphous in other respects. Some examples are :

	P.	A.	G.
M. lancifolia ...	14–10	28–22	14–10
Kingiana ...	16–12	36–32	10–8
betis ...	10–8	20–16	8
sericea ...	9–8	24–18	10–8
Endertii ...	7–6	13–12	7–6
macrophylla ...	13–10	28–20	18–11

etc.

M. Ridleyi has the highest numbers for G. As to P. it is only equalled by *M. macrophylla*, as to A. it is only surpassed by *M. Lecomteana* (nom. nov. for *Bassia Thoreliana* Pierre), in which P. = 40–35. Only 3 other species, all from the Malay Peninsula show similar P. numbers, except a Burckella species, discussed below.

Payena. P. 8–6 A. 20–12 G. 8–6.

These extremes are exceptions. About 12 species out of 16 of which all whorls are completely known, show the 8–16–8 arrangement, many others show little variations and only a few, some of which are polymorphous throughout, are more various, *viz. P. lucida* (8–6, 16–13, 8–6), *P. dasyphylla* (8, 20–16, 8), *P. Griffithii* (8-6, 16–12, 8) and *P. truncata* n. sp. (8–7, 16–4, 8?).

Ganua. P. 8–6 A. 24–16 G. (12?–) 9–6.

In this small genus the variability is somewhat more pronounced than in *Payena*. Yet, most of the species are fixed to the 8–16–8 type or almost, and, as in *Payena*, the most striking variability occurs in species that are also polymorphous in other respects, such as *G. Motleyana* (10–8, 20–16, 8–6) and *G. monticola* (8, 24–16, 12?–9–8).

Burckella. P. 8–6 A. (40?–) 18–9 G. 6–3.

There is hardly any variability in the corolla; only one species is said to possess 6 petals. In the androœceum three species have 18–16 stamens, one has 16–9 and one (*B. Thurstonii* [HEMSL.] H. J. LAM, from Fiji) is said to have as many as 40 (p. 8, G. 4).

This fact gives me an opportunity to say a few words on the phylogenetic value of the three whorls mentioned. As may appear also from the following statement, the corolla and the androœceum seem, in general, not to yield valuable and trustworthy data for phylogenetic conclusions. There is only a slight indication as to a reduction of the P and A. numbers in three Ceylon species of *Madhuca* (6–12–6). For the rest, it may even be that these whorls are not always subject to a reduction but may, on the contrary, in some cases, attain higher numbers by progression. This not uncommon phenomenon is *e.g.* illustrated by the figure of the androœceum of *Burckella* (*Bassia*) *Thurstonii* in HOOKER'S Icones Plantarum t. 2569 (XXVI, 1899), in which a petaloid stamen is figured and also by the fact that stamens with halfway split anthers are not rare in the group of the *Palaquiinæ*. This made me refrain from laying any particular stress upon the phylogenetic value of the characters of these two whorls.

The gynæceum, however, being an organ of much less phylogenetic plasticity as a rule, is more reliable in this respect, and shows a distinct reduction in the more remote parts of the area. It does so in all of the four genera; in *Payena* this reduction is hardly conspicuous (down to 6 in 3 out of the 19 species in which this feature is known); in *Ganua*, being also in other features more isolated (ovary, fruit, venation) it become more apparent (down to 6 in 3, to 7 in another of 9 species); in *Madhuca* the genus with the highest G. numbers this reduction is occasionally found (*viz.* down to 6 in 2, 7 in 1 W. Malaysian, down to 5 in 1, to 6 in 7 and to 7 in 1 Continental species). It is also a striking fact that in *M. mindanænsis* the Philippine specimens possess 8, the North Borneo ones (living in a place which is probably colonized from the main area in the Philippines) 6 cells in their ovaries. None of these genera, however, have a G. number below 6. This is only reached in *Burckella* where there are 6, 5, 4 or 3 cells, however, wihout more detailed geographic correlation with the accepted general migration from West to East.

The following table gives the average numbers in the whorls in question in order to show any geographic importance :

——	P.	A.	G.	% of species in which G =							
				>9	9	8	7	6	5	4	3
MADHUCA											
W. Malaysia	9·1 (33 sp.)	20·6 (33 sp.)	9·3 (32 sp.)	46	52	66	13	6	..	..	..
C. & E. Malaysia ..	8·4 (4 sp.)	21·2 (4 sp.)	8·1 (4 sp.)	..	25	75	25	25	..	..	..
Cont. of Asia—											
E. Peninsula ..	9·5 (8 sp.)	20·4 (9 sp.)	8·1 (10 sp.)	30	20	80	50	40	..	..	..
W. Peninsula ..	8·8 (4 sp.)	20·5 (4 sp.)	7·5 (3 sp.)	33	33	67	67	33	33	..	..
Ceylon	6 (2 sp.)	12 (2 sp.)	6 (2 sp.)	..	..	..	..	100	..	..	..
PAYENA											
West Malaysia, Cont. of Asia (E. Penins.) (no difference)	7·8 (18 sp.)	15·7 (20 sp.)	7·8 (19 sp.)	..	..	100	16	16	..	..	..
GANUA											
West Malaysia, 1 species in Moluccas (no difference)	8·1 (8 sp)	16·8 (8 sp)	7·7 (9 sp.)	11?	22	77	44	44	..	..	..
BURCKELLA											
Moluccas, N. Guinea, Polynesia (no difference) ..	7·6 (7 sp)	16 (*6 sp.)	4·6 (8 sp.)	..	..	..	..	25	63	63	13

* *Note:*—Including *B. Thurstonii* (*see* note above), the A. average (of 7 sp.) would be 21.

It appears, I think, especially from the percentage data, that there is a tendency to be traced to reduce the number of carpels as the distance from the centre of dispersion is greater, both to the West (India, Ceylon) and the East (Polynesia). That this reduction is more distinct in the East may readily be ascribed to the preponderant insular character of those parts. In the other whorls, there is no correlation, possibly partly due to an eventual tendency to raise the number of petals and stamens *e.g.* by what has sometimes been called a reduplication ("dédoublement").

The above facts have been combined with my general ideas on the dispersion of the whole group in a tentative "genealogical branch" (Pl. 6) which may speak for itself, but concerning which I must state that, of course, complicated processes as the phylogeny of a group of plants can never be symbolized in a thoroughly satisfactory way on a sheet of paper; furthermore I have to emphasize that the "branches" are not meant to be "solid", but should be imagined as sponge-like tissues of extremely complicated structure. For the rest, I am quite aware of the very problematic value of such considerations and ideas.

A description and analysis of the new species may follow here:

Madhuca Ridleyi (Sect. *Dasyaulus*), nova species, Pl. 7— Arbor mediocris, ramuli crassi; internodiis brevibus bulboso-inflatis, 1.5–2 cm. longis et latis rugosis; folia ad eorum apices dense conferta; stipulæ deciduæ 0.3–1.2 cm. longæ pubescentes; folia coriacea glabra, obovata vel oblongo-obovata, 14–25 cm. longa, 5–10.5 cm. lata, basi in petiolum glabrum 1.5–3.5 cm. longum, 0.2–0.3 cm. crassum attenuata, apice acuta vel subrotundata; costa media i.s. supra canaliculata, subtus valde prominens; nervi secundarii subtus prominentes, 18–25, angulo 60°–70° de costa adscendentes, recti, prope marginem curvati, diminuti, haud conjuncti, 0.7–1 cm. distantes; nervi tertiarii transversi, angulo circ. 120° de costa descendentes, subtus conspicui, reticulatione perminuta, interdum nervo brevi secundariis parallelo a costa media usque ad ⅓–½ adscendente; *inflorescentiæ* ex foliorum delapsorum axillis ortæ, nonnullæ ad ramulorum longorum rectorum apices dense confertæ, 15–25–floræ, pedicelli minute tomentosi, graciles, 2–2.5 cm. longi; alabastra acute ovoidea; *calyx* 1–1.3 cm. longus, sepala extus dense minute fulvo-ferrugineo-tomentosa, intus glabra, angula apicale circ. 90°, exteriora 1.25 cm. longa, 1 cm. lata, interiora 1.3 × 1.1 cm.; *corolla* in alabastris vix exserta (flores novellos tantum vidi) 1.1–1.2 cm. longa, extus glabra vel subglabra, intus glabra; petala 18 uniserialia dextrorsum tegentia 0.95–1 cm. longa, 0.4 cm. lata, margine plus minusve irregulariter minute denticulata; *stamina* glabra 36–37, plerumque uniserialia, interdum nonnulli serie imperfecta addita, 0.5–0.6 cm. longa, nova filamenta usque ad 0.2 cm. longa, antheræ 0.2–0.35 cm. longæ, 0.15 cm. latæ, apice

acumine acuto 0.075–0.15–0.25 cm. longo ornatæ; *ovarium* glabrum depressi-globosum extus paulo sulcatum, 18–21- loculatum; loculi 1-ovulati; stylus solidus in alabastro 0.9 cm. longo; *infrutescentiæ* ramulorum apicibus subumbellatim confertæ, pedicelli 2.5 cm. longi, 0.25–0.3 cm. crassi, apice vix dilatati; calyx persistens, sepala 1–1.8 cm. longa, extus tomentosa; *fructus* globosi, apice sæpe stylo 3 cm. longo persistente ornatus, dense ferrugineo-pubescentes, pericarpio crasso subduro; 4–6 semina oblonga, testa tenuis, extus nitida; cetera ignota.

Malay Peninsula: Pahang, Bukit Serdam, Raub, 1300 ft., on dry limestone rocks (HENDERSON 25055, flowers, on 6 Oct. 1931, *type specimen*)—Upper Perak, Gunong Runto, Lenggong, 500 ft., on limestone (HENDERSON 23834, fruits on 11 June, 1930).

A small but rather stout tree, both specimens known growing on limestone; bark pale, horizontally and longitudinally fissured; fruits rusty brown.

I have to thank Mr. K. GRIFFIOEN for his assistance in preparatory work for this paper, and my colleague, Dr. L. G. M. BAAS BECKING for kindly looking over the English.

Summary.

After some theoretical considerations on modern phylogenetical Taxonomy as a discipline, dealing with morphological as well as geographical evolution and newly influenced by Genetics, it is stated that next to Paleobotany two categories of data may be considered important for our ideas on Phylogeny, *viz.* the present distribution of species and that of features. This is illustrated by examples taken from the *Eumadhuceæ*, a group of East-Asiatic to Polynesian Sapotaceæ. It is shown that the former Sunda-land is the most probable place of origin of this group and that the species have migrated both westward (India, Ceylon, Indochina) and eastward (Polynesia). Evidence for this suggestion is found in the distribution and evolution of certain features, especially in the reduction of the number of carpels in both directions mentioned. The paper was stimulated by the discovery of a new *Madhuca*-species, *M. Ridleyi*, from British Malaya, the gynæceum of which shows the highest number of carpels known in the whole group. A description of this species is added.

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Explanation of Plates 3-7.

Plate 3

Present Distribution of the Eumadhuceæ.

Well known species only; numbers between brackets under genera indicate total number of species, in the other columns they indicate the number of endemic species in the region concerned; however, it must be borne in mind that amongst these are a number of new and more recent species.

Plate 4

Areas of *Madhuca* (M), *Payena* (P), *Ganua* (G) and *Burckella* (B) and total number of species (*Eumadhuceæ*) in the separate regions.

Plate 5

Probable lines of migration.

Plate 6

Probable phylogeny of *Eumadhuceæ*.

Plate 7

MADHUCA RIDLEYI, n. sp.—a. branch with leaves; b. shoot with inflorescences; c. id. with fruits; (d) flowerbuds; e. outer sepal, in- and outside; f. id. inner sepal; g. corolla inside; h. petals; k. stamens; m. pistillum; n. ovary, cross-section—after HENDERSON 25055, except c. which is taken from HENDERSON 23834.

Plate 3 *Gardens Bulletin, S.S.*

SAMOA
FIJI
TONGA
B
G
P
G
M
1
2
3
4
7
13
28
39
43

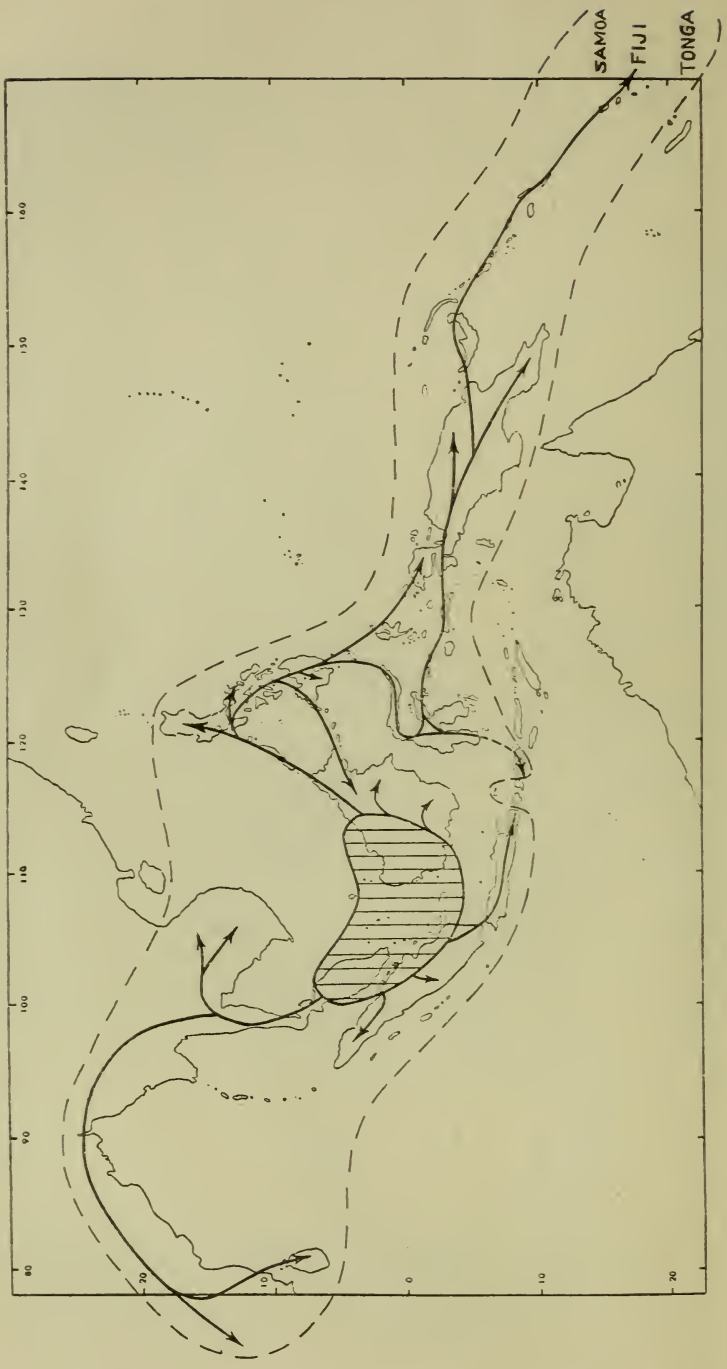

Plate 5 *Gardens Bulletin, S.S.*

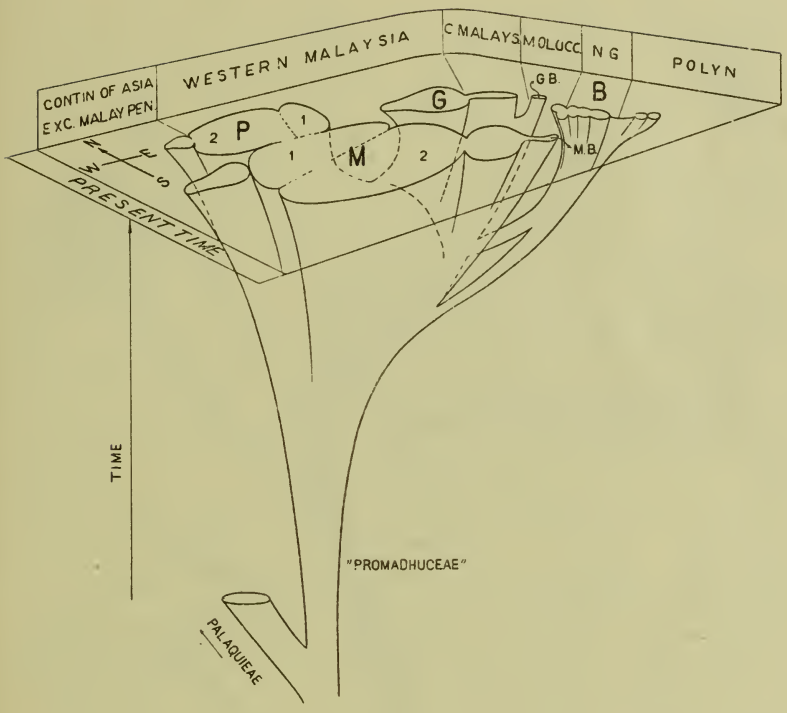
CONTIN OF ASIA
EXC. MALAY PEN.
WESTERN MALAYSIA
C MALAYS
MOLUCC
N G
POLYN
G
GB.
B
P
2
1
1
M
2
MB.
PRESENT TIME
TIME
"PROMADHUCEAE"
PALAQUIEAE

Plate 7

Gardens Bulletin, S.S.

CHONEMORPHA MACROPHYLLA AND ALLIED SPECIES.

C. X. Furtado,
Botanic Gardens, Singapore.

Introduction.

Although *Chonemorpha macrophylla* G. Don is the type of the genus as currently interpreted, it is a species whose limits are not yet clearly defined, with the result that more than one species are included under that specific name, and this holds good even after the exclusion of the Philippine and Javanese material that was previously referred here. It is true that Ridley, acting on Stapf's suggestions on this matter, had (in *Agric. Bull. Straits & Fed. Malay States* X, 1911, pp. 146-148) created two new specific epithets, *C. penangensis* and *C. Rheedei*, hoping to straighten out the matter. But, as he did not bring out fully the chief characters that distinguish the three species, his paper did not succeed in making matters much clearer, and moreover his paper with Stapf's suggestions being published in a periodical of purely agricultural and local interest, failed to attract the attention of horticulturists and systematists even to the fact that *C. macrophylla* as then interpreted was being regarded as a mixed species. It is not surprising therefore that the two *Supplements* to *Index Kewensis* for 1911-15 and 1916-20, published respectively in 1921 and 1926, were issued without including Ridley's two new species, their inclusion not appearing until 1929 when the *Supplement* for 1921-25 was issued and when presumably the compilers' attention was drawn to Ridley's paper through a reference made to it in Ridley's *Flora II*, 1923.

In the hope, therefore, that the circumscription of *C. macrophylla* G. Don may become clear, and that the separation of the species usually confused with it may be easier, I have prepared the *Key* and the *Enumeration* given below. This paper not being a complete revision of the genus, I limit myself to giving only those synonyms and references which I consider may be useful to interpret the species correctly. I have also described a new species *C. assamensis*, based on a specimen from Assam.

The species are so variable as regards the hairiness and size of the leaves that it is not easy to distinguish them on that character. The general outline of the leaves, the comparative size of the corolla and the hairiness, size and shape of the calyx are more stable characters and so advantage is taken of them in framing the key. The hairiness of the pistil is apparently a useful character in separating these species, and may form an important basis in subdividing such polymorphous species as

C. macrophylla and *C. mollis;* but the material at my disposal was so meagre in flowers that I did not feel myself justified to detach flowers from the authentic specimens for the purpose of dissection.

From the enumeration given below it will be evident that the success of my inquiry into the various species commonly referred to *C. macrophylla* is due principally to the rich material preserved in the herbarium of the Royal Botanic Gardens, Calcutta. My thanks are therefore due to the Director of that institution for the loan of the specimens.

Key to the Species.

A Leaves of the flowering shoots elliptic to obovate, usually more narrowed in the lower half than in the upper; base rounded, obtuse or slightly cordate. Calyx glabrescent or distinctly hairy, urceolulate or companulate or crateriform; lobes triangular.

a: Calyx distinctly hairy or velvety, about 10–12 mm. long, slightly contracted at apex; lobes triangular, about ⅓ the total length of the calyx. Corolla tube 3–3.5 cm. long; limb 5–6.5 cm. across.

1. *C. penangensis.*

aa: Calyx glabrous or glabrescent, not contracted at apex;

b: Calyx glabrescent, 9–12 mm. long, campanulate; lobes about ⅓ the length of the calyx. Corolla tube 3–4.5 cm. long, contraction towards the base begins at the mouth of the calyx; limb 7–9 cm. across.

2. *C. macrophylla.*

bb: Calyx 4–5 mm. long, crateriform, glabrous; lobes about ½ the length of the calyx. Corolla tube 3–4.5 cm. long, contraction towards the base begins much above the mouth of the calyx; limb 7–8 cm. across.

3. *C. assamensis.*

AA Leaves of the flowering shoots ovate, oval elliptic-oblong, or almost orbicular, usually more narrowed in the upper half than in the lower; base rounded, cordate. Calyx glabrescent, campanulate; lobes triangular or ovate.

a: Calyx 10–13 mm. long; lobes ⅓ the length of calyx, triangular. Corolla tube 2–2.5 cm. long; limb 6–7 cm. across.

4. *C. mollis.*

aa: Calyx 7–10 mm. long; lobes ovate, gradually and arcuately narrowed towards the apex, overlapping at base, ½–⅔ the length of calyx. Corolla tube 2–2.5 cm. long; limb 7–9 cm. across.

5. *C. fragrans.*

Enumeration.

1. C. assamensis Furtado **spec. nov.**

A *C. macrophylla* G. Don, cui affinis, calycibus glaberrimis brevioribus, cupuliformibus; corollarum tubo supra (haud ad) calycum orificium dilatato; hæc species facile distinguenda.

A *C. fragrante* Alston calycum lobis trianglaribus, ramulorum foliis floriferorum obovatis distat.

India: *Assam,* loc. incert (collected by a native collector under the supervision of G. Mann, in May 1893. Holotype in the Calcutta Herbarium).

2. Chonemorpha fragrans (Moon) Alston in Ann. Roy. Bot. Gard. Perad. XI (1929) 203 excl. syn., et in Trimen Fl. Ceyl. VI (1931) 192 p.p.

Echites fragrans Moon Cat. (1821) 20. Type.

C. Rheedei Ridl. in Agric. Bull. S. & F.M.S. X (1911) 146. *Syn. nov.*

C. macrophylla G. Don *sensu* Thwaites, Enum. (1864) 194; Hook. f., Fl. Brit. Ind. III (1882) 661 p.p. ; Trim., Fl. Ceyl. III (1895) 138 quoad specimina zeylanica; Cooke, Fl. Pres. Bombay II (1904) 139 quoad descriptionem et specimina citata; Gamble, Fl. Pres. Madras V (1923) 818 quoad specimina Indiæ australis. *Syn. nov.*

Belutta-Kaka-Kodi Rheede, Hort. Malab. IX (1689) p. 7, tt. 5 & 6. (Type of *E. fragrans* Moon).

Ceylon: loc. incert. (Thwaites, C.P. 2467 in Calcutta herb).

Cultivated specimens: *Singapore:* Botanic Gardens (Ridley, in 1911, holotype of *C. Rheedei*).

3. Chonemorpha macrophylla [Roxb.] G. Don, Gen. Syst. Dichl. Pt. IV (1838) 76; DC., Prodr. VIII (1844) 430, p.p.; Miq., Fl. Ind. Bot. II (1856 444 p.p; Thwaites, Enum. (1864) 194 p.p.; Hook., f., Fl. Brit. Ind. III (1882) 661 p.p.; Trim., Fl. Ceyl. III (1895) 138 p.p. Hook.f. Bot. Mag. (1896) t. 7492. Gamble in King, Mat. Fl. Mal. Pen. IV (1907) 693 p.p.; Ridley in Journ. Roy. Asiat. Soc. Str. Br. 57 (1910) 68.

C. macrophylla var. *grandis* A.DC., Prodr. VIII (1844) 450. *Syn. nov.*

C. penangensis Ridl. in Agric. Bull. S. & F.M.S. X (1911) 147 quoad specimina perakensia, et Fl. Mal. Pen. II (1923) 360 p.p. *Syn. nov.*

Echites macrophylla Roxb. sp. nov., Hort. Beng. (1814) 20, nom. nud., et Fl. Ind. II (1824) 13 excl. syn. *Type.* [non *E. macrophylla* H.B.K., Nov. Gen. et. Spec. III (1819) 219].

E. grandis Wall. Cat 1658, nom. nud.

E. latifolia Wall. Cat. no. 1657 E, nom. nud.

India: *N. W. Himalaya,* Dehra Dun (Mackinnon in Aug. 1897). *W. Duars,* Buxa (Gamble, 7698). *Prov. Incert.,* Teendaria (Gamble, 3223 B & C); loc. incert. (Falconer). *Assam* and *Sikkim:* Sillet (Wall. Cat. 1657A); Kom (Wall. Cat. 1658); Kumaon (leg.?, in 1871); Goyalpara (Wall. Cat. 1657E); Slik (Rebu, 873).

Burma *Shan States,* loc. incert. (Allen, 2); Lashio alt 2,600 ft. (Lace, 5838).

Andamans: (Prain's coll., 57; Parkinson, 619).

Malay Peninsula: *Perak,* Temengo (Ridley, 14271); Larut, alt. 300–500 ft. (Kunstler, 3636); Gopeng, alt. 300–500 ft. (Kunstler, 6,000).

Cultivated specimens: India, Botanic Gardens, *Calcutta* (Wallich, 1657B; Lane, 11,270). Malay Peninsula: *Singapore,* Botanic Gardens (Furtado, Nov. 15, 1935). *Selangor,* Kuala Lumpur in Public Gardens (Nov. 27, 1932).

With the exception of those from the Malay Peninsula, all specimens cited above are from the Calcutta Herbarium. The species is variable as regards the breadth and glabrescence of the calyx.

4. Chonemorpha mollis Miq., Fl. Ind. Bot. II (1856) 444. *stat. nov.*

C. macrophylla G. Don *sensu* Vidal, Cat. Pl. Prov. Manila (1880) 36; Hook. f., Fl. Brit. Ind. III (1882) 661 p.p; Koorders, Exkursionsfl. Jav. III (1912) 77; Heyne, Nutt. Plant. Nederl. Ind. IV (1917) 85, et 2nd Ed. II (1927) 1291. *Syn. nov.*

C. Blancoi Merr., Spec. Blancoanæ (1918) 312, et Enum. Philipp. Pl. III (1923) 335. *Syn. nov.*

C. elliptica Merr. & Rolfe in Philpp. Journ. Sci. III (1908) 121. *Syn. nov.*

Tabernæmontana elliptica Blanco sp. nov. Fl. Filip. (1837) 115 (non *T. elliptica* Thunb., Fl. Jap. 1784, p. 111). *Syn. nov.*

Java. (Horsfield, duplicate of the Type, in Calcutta herb.).

Celebes: Bonto Parang (Bünnemeijer, 10572).

Philippines: *Luzon,* Borhoso (Ahern, 1141; Ramos, 1065). *Palawan,* Taytay (Merrill, 9249).

This species, like *C. macrophylla,* is very variable as regards the pubescence and the size of leaves and calyces. A further inquiry into the hairiness of the pistil and the corolla tube may be desirable to understand the exact significance of the several variations.

5. Chonemorpha penangensis Ridley in Agric. Bull. S. & F.M.S. X (1911) 147 excl. specimina perakensia, et Fl. Malay Pen. II (1923) 360 p.p.

C. macrophylla G. Don *sensu* Hook. f., Fl. Brit. Ind. III (1882) 661 quoad specimina malaccensia; Gamble in King, Materials IV (1907) 693 p.p.

Malay Peninsula: *Penang,* Balek Pulau (Ridley, 9441); Wang Seraya, alt. 500 feet (Curtis, 832); Ayer Etam (Haniff, in April 1916, vern. name: Gĕrip Merah), *Malacca,* Brisu (Derry, 543, vern. name: Akar Gĕrip-Gĕrip Merah.; loc. incert (Maingay 1074 = Kew n. 1837, in Calcutta herb.). *Negri Sembilan,* Tampin Hill (Burkill, 556). *Selangor,* Kepong (Symington, 20148; Pawanche, 14673, vern. name Akar Gĕrit Tembaga.).

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THE

GARDENS' BULLETIN

STRAITS SETTLEMENTS

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THE

GARDENS' BULLETIN

Vol. IX 4th May, 1937 Part 2

NOTES ON MALAYAN FERNS, WITH DESCRIPTIONS OF FIVE NEW SPECIES.

By R. E. Holttum.

At various times during the past few years I have collected notes on ferns of the Malay Peninsula, and have gathered them together here, with descriptions of five new species, *Davallia dimorpha, Diplazium insigne, D. latisquamatum, D. subintegrum,* and *D. velutinum.* The larger Diplaziums, inhabiting the mountain valleys from about 2,000 ft. upwards, still require much field study, and also careful comparison with the species of neighbouring countries. There are certainly several further additions to be made to the Peninsula species of this genus.

The notes here published are of various kinds. Most are additions to the recorded fern flora of the Peninsula, chiefly based on recent collections, but in some cases on redetermination of old collections. Some are critical notes on nomenclature, based either on my own study of type specimens, or copied from other sources, which are duly acknowledged. There are also field notes on many species, based on my own observations.

Acrostichum speciosum Willd. Spec. Plant. 4 Aufl. **5:** 117. 1810. Troll, Flora N. S. **28:** 301 – 327. 1933.

As pointed out by Dr. Troll, this species is quite distinct from *A. aureum,* with which it has been united by most authors. Watson, in *Malayan Forest Records No. 6,* pp. 152–157, gives an account of the two forms of Acrostichum occurring in Malayan mangrove; they are so distinct that local Malays have given them different names. The larger *A. aureum,* which may reach 4 metres in height, is called *Piai raya;* the smaller *A. speciosum* is called *Piai lasa.* Both species are abundant. *A. speciosum* occurs especially "where there are plenty of prawn heaps on which it can grow above the reach of the medium high tides."

Aplenium glaucophyllum v.A.v.R., Bull. jard. bot. Buitenz. II ser. VII : 6. 1912. *A. polystichoides* Bl. Mett. Asplenium 204. 1859 (nomen).

This species, described from Borneo (Nieuwenhuis no. 864), is not uncommon in the lowlands of the Malay Peninsula. The

specimens have hitherto been referred with doubt to *A. nitidum* Sw., to which species Mettenius referred as a variety the specimen of Korthals named *A. polystichoides* in Blume's herbarium. The species has been adequately described by van Alderwerelt van Rosenburgh, but some additional notes may be of interest. These are based on the material in the Singapore herbarium, and on a plant cultivated in the Botanic Gardens, Singapore. The cultivated plant occurred spontaneously on the base of an old Asplenium nidus on an African Oil Palm (*Elæis guineensis*), and was subsequently removed to a hanging basket.

The characteristic features of the species are the very long relatively narrow fronds (lamina commonly about 85 by 30 cm.), and the large pinnules, which are not pinnate but are commonly rather deeply incised once on the upper margin towards the base. Occasionally a specimen has the pinnules quite entire, except for the rather distant teeth (*e.g.* Burkill 17265 from Pekan, Pahang), while on very large fronds the largest pinnules may have several lobes, the lowest almost separated as a distinct leaflet. An extreme example of a lobed form is a specimen of Burkill's from Pulau Tioman (s.n., June 1915), but a quite comparable development is seen on the largest frond of the cultivated plant. The smallest fronds on the cultivated plant are quite small, but are fully fertile. The pinnules are almost all rounded at the apex, whereas on larger fronds the pinnules are gradually narrowed to an acute apex.

The stipes of young fronds are green, blackening with age; on old fronds the rachises are all black. The stipes and rachises are dull, not polished, and when young are clothed with very small narrow dark scales. The densely crowded scales on the apex of the rhizome are thin, dull purplish-brown, to at least 2 cm. long and 1 mm. wide. The colour of dried fronds varies from a rather pale olive to brown, and the colour of stipe and rachis from greenish-grey to black. Specimens in the Singapore herbarium are as follows. The Perak specimens are all small, and were labelled *A. nitidum* var. *obtusatum;* they match very closely the smallest fronds of the cultivated plant above mentioned.

SINGAPORE: Bukit Timah, Ridley s.n. 1906; do. 1907; Woodlands, Matthew s.n.; Mt. Austin, Ridley s.n. 1906. JOHORE: G. Pulai, Hullett s.n. Aug. 1880; Haji Senawi, Tempayan River, Ridley 10965; Tempayan River, Ridley 13286; Gunong Lambak, Holttum 9375; Mengkibol Station, Gossett 8314. SELANGOR: Batu Caves Woods, Ridley 8144. MALACCA: Harvey s.n. PAHANG: Pulau Tioman, Ridley s.n. 1889, Burkill s.n. June 1915; between Pekan and Ayer Tawar, Burkill 17265; Kuala Lipis, Burkill 17078; Tahan River, Ridley s.n. 27-9-1893.

KELANTAN: Sungei Keteh, Md. Nur 12037. PERAK: Gopeng district, King's Collector 8180; Upper Perak, L. Wray Jr. 3657.

Asplenium subnormale Copel. Perk. Frag. p. 183, pl. 4, f.B. 1905.

This species has not hitherto been recorded from the Malay Peninsula. It has been collected by Burkill on Pulau Tioman, S. Cape, close to the sea, no. 1036. I have seen specimens from Sarawak and British North Borneo.

Asplenium subscalare v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XX: 6 1915.

This species was described from a specimen originating from "Malacca", cultivated in the Botanic Gardens, Buitenzorg. The specimen was at first named *A. spathulatum* Bak. by v.A.v.R., whence the statement in his Handbook that *A. spathulatum* occurs in the Peninsula. A specimen of Scortechini's from Taiping, no. 129, labelled in his hand *A. abruptum* (a *nomen nudum*), is apparently the same as this species. Scortechini 243, from Maxwell's Hill, 3,000 ft., is perhaps also to be referred here; the plants are young.

Athyrium macrocarpum (Bl.) Bedd. F.S.I. t. 152. 1863. *Aspidium* Bl. Enum. 152. 1828.

This species has not hitherto been recorded as occurring in the Malay Peninsula. It has been found by me (no. 23462) on wet rocks at Cameron Highlands, beside the stream, with *Lindsaya cultrata*.

Athyrium nigripes (Bl.) Moore, Index XLIX. 1857. *Aspidium* Bl. Enum. 162.

This species was collected by Ridley on G. Berumban, no. 14001, and the specimen was named *Asplenium tenuifolium* by Beddome (Kew Bull. 1909: 423). I collected it later (no. 23275) it Cameron Highlands, where it was abundant in the forest near the stream at about 4,800 ft. altitude. This is the first published record of its occurrence in the Peninsula.

Bolbitis diversifolia (Bl.) Schott, Gen. ad t. 14. 1834.

Bolbitis subsimplex (Fée) Ching in C. Chr. Ind. Suppl. III: 50. 1934. with synonyms.

At the herbarium at Leiden I examined three specimens of Blume's, referred to this species, and I can see no difference from the common fern in the Peninsula which is clearly *Campium subsimplex* as described by Copeland (Phil. Journ. Sci. **37:** 356. 1928). One of Blume's specimens has simple fronds, the others pinnate. The species is common on rocks, usually by streams, in lowland forest throughout the Peninsula. Young plants always have simple fronds, and occasionally simple fertile fronds are produced.

Bolbitis Quoyana (Gaud.) Ching in C. Chr. Ind. Suppl. III: 49. 1934.

This species has not hitherto been reported as occurring in the Malay Peninsula. The only specimens which can now be so referred are from Bukit Timah, Singapore: Ridley 12569, Holttum 19799, Hullett s.n. March 1882. These specimens are not typical of the species, having pinnæ only very slightly lobed, but I do not know any other species to which they could be referred.

Cheilanthes varians (Wall.) Hk. Spec. Fil **2:** 89, t. 103A. 1852.

This species occurs in the north of the Peninsula, but has not hitherto been reported. Collections in the herbarium at Singapore are: KEDAH, Kampong Naka, Holttum 19814; Langkawi, Curtis s.n. I found the fern not uncommon, under the shade of rather open secondary forest.

Cyclopeltis crenata (Fée) C. Chr. Ind. Suppl. III: 64. 1934.

Hemicardion Fée Gen. 283, t. 22A, f. 1. 1852.

Specimens of Cyclopeltis from the Malay Peninsula have previously been referred to *C. semicordata,* the type of which is from tropical America. Fée's description and figure agree well with Peninsular plants which are quite distinct from the Philippine *C. Presliana.*

Cystopteris tenuisecta (Bl.) Mett. Ann. Lugd. Bat. **I:** 241. 1864.

This interesting species has lately been collected at Cameron Highlands (S.F.N. 31297, Holttum). Plants were found growing abundantly on the banks of a path cut in rather moist but lightly shaded forest at 5,000 ft. altitude. The same locality was visited before the path was cut, and no plants of the species noticed; they evidently found the moist newly cut earth a suitable habitat. No other plants were noticed in the neighbourhood, where the species is certainly not common, and no previous collections have been made in the Peninsula.

There are notes on *C. tenuisecta* by Posthumus in Bull. Jard. bot. Buitenzorg, Ser. III, vol. 13, p. 91. In the Malayan region it has been rarely collected, being known from N. Sumatra, a few localities in Java, and Luzon. It evidently requires a specialised habitat.

Davallia dimorpha Holttum sp. nov.

D. Griffithii affinis, differt: frondibus dimorphis, in sicco rufobrunneis, segmentis ultimis laminæ fertilis perangustatis.

Scales of the rhizome red-brown, shining, to 1 cm. long and 3 mm. wide above the peltate base, narrowed gradually to acuminate apex, edges subentire. *Stipes* of large fronds 30–40 cm. long, red-brown to dark purple-brown. *Lamina of sterile frond* deltoid, to about 45 cm. long and 30 cm. wide, pinnæ

subcontiguous, the segments of the pinnules contiguous or subcontiguous; pinnules separated by not more than half their width, more or less elliptical in shape, the edges bluntly serrate, apices rounded; texture coriaceous; colour of dried fronds rather light red-brown (often darker on older fronds); veins distinct, elevated; no spurious veins. *Lamina of fertile frond* to about 45 cm. long and 30 cm. wide, the pinnæ and pinnules of similar shape, size and spacing to those of the sterile frond, but the lamina of the pinnule-segments cut down to a narrow wing on either side of the veins, each segment terminating in a semicircular widened portion to accomodate the sorus; occasionally but not commonly the lamina prolonged into a tooth or horn beyond the sorus on one side; *sori* broader than long, often twice a broad, the indusium almost crescent-shaped, occupying almost the whole of the widened ends of the segments.

Type.—Pahang: Brinchang, Cameron Highlands, alt. 5,000 ft., S.F.N. 31289 (Holttum), in Herb. Singapore.

This remarkable species has only been found at Cameron Highlands, on the Main Range of the Peninsula. It is evidently allied to *D. Griffithii*, with which it agrees in the very broad sori, but differs very strikingly in the much-narrowed fertile pinnule-segments, which carry at their ends the almost crescent-shaped sori. The rather bright red-brown colour of dried fronds which are not too old when collected is also notable.

Diplazium insigne Holttum sp. nov.

Caudex brevis erectus. Stipites 1 m. longi, basin versus aculeati; aculei tenues, ad 2 mm. longi, primo paleas sordides angustas, ad 1.5 cm. longas, margine nigro-dentatas, ferentes, demum nudi. Lamia 1.5 m. longa, bipinnata. Raches minute paleaceæ; paleæ irregulares, majores dentatæ. Pinnæ infimæ 28 cm. longæ, 6.5 cm. latæ, basi angustatæ, medio ad costam lobatæ, lobi leviter obliqui, rotundati vel acuti, margine minute dentati. Pinnæ maximæ ad 60 cm. longæ, 16 cm. latæ, pinnatæ. Pinnulæ leviter obliquæ, omnes ad rachin adnatæ; pinnularum infimarum basis adnata 5 mm. lata, superiorum latior. Pinnulæ maximæ 9 cm. longæ, 2.3 cm. latæ, basi angulo 45° cuneatæ, e basi sensim angustatæ, apice 1.5–2 cm. multo angustatæ, margine leviter serratæ, textura firmiter herbaceæ, colore subtus pallidæ, supra atrovirides. Venulæ more D.accedentis anastomosantes, et soros ferentes.

Type.—Pahang, Fraser Hill, in Tras valley, 3,800 ft., Singapore Field Number 21635 (Holttum), in Herb. Singapore.

This species is in every way closely allied to *D. accedens* Bl., but is bipinnate (with slightly adnate pinnules) instead of simply pinnate. *D. stenochlamys* C. Chr. appears to be an allied but much smaller species. The type of *D. insigne* was a very fine large plant, inhabiting moist shady valley forest.

The mountain valleys of Malaya at 2,000–4,000 ft. altitude have been much less explored than the ridges, and, especially in ferns, contain a very rich flora. It is possible that *D. insigne* may be fairly widely distributed at such altitudes on the main range of the Peninsula. I found a young sterile plant, probably of this species, at about 2,000 ft. altitude near Ginting Simpah, some 25 miles south of Fraser's Hill, on the other side of the range.

Diplazium latisquamatum Holttum sp. nov.

Caudex brevis erectus. Frondes juveniles circinnatae squamis nigris rotundatis vel ovatis peltatis integris imbricatis vestitae. Stipites ad 90 cm. longi, basin versus vel omnino scabridi vel papillati, cum rachibus minute paleacei. Lamina ad 1.5 m. longa et 1 m. lata, tripinnatifida. Costae supra bialata, subtus squamis parvis subrotundatis paucis munitae, lamina cetera glabra. Pinnulæ sessiles basi late cuneatæ vel subtruncatae, apicem versus leviter angustatae, ad alam 2-3 mm. latam lobatæ, apice acuminatæ serratæ, textura firmiter herbaceae; lobi leviter obliquae, plerumque 4 mm. lati, oblingi, apice truncati, subintegri vel serrati. Venulae in lobis 5-6-jugatæ, simplices vel superiores furcatae. Sori dimidium inferum venularum solum occupantes; indusia persistentia.

Type. Pahang, Sungei Terla (Ulu Telom), S.F.N. 31311 (Holttum), in Herb. Singapore.

Other specimens.—Pahang: Cameron Highlands S.F.N. 23297, 23360, 31353, 31381. B. N. Borneo: Mt. Kinabalu, S.F.N. 25429; Clemens 27122, 32952, 32551, 33682, 32454, 32516.

The characteristic features of this species are the broad almost black imbricating scales on the young circinnate fronds, the tripinnatifid habit, and the sori confined to the basal half of the veins. In other characters there is much variation, due in part to the fact that plants immature in size may be fertile. The scales on the stipes, as the frond expands, are mounted on soft papillæ, which remain after the scales have fallen; but the degree to which these papillæ are developed seems to be very variable. S.F.N. 23297 has abnormally broad lobes to the pinnules, the ends rounded, and sometimes lobed again. In other characters it agrees with other specimens, and in view of the variation of cutting which clearly exists in the species, I can only regard it as a local variation. The Kinabalu specimens agree well, the only notable differences being that the scales tend to be ovate-acute, and the stipes on the whole more smooth.

This species is characteristic of moist shady valley forest in the neighbourhood of Cameron Highlands, at 4,000–5,000 ft. The plants often grow in very wet ground.

The Kinabalu specimens were at first identified with *D. atrosquamosum* (Copel.) C. Chr. This is clearly an error, in

view of the very broad scales, the scales of *D. atrosquamosum* being narrow.

A recent collection (S.F.N. 31193, Holttum) from an altitude of 2,500 ft. at Ginting Simpah (on the Main Range, south of Cameron Highlands) appears to belong to this species. The pinnules are broader than in any other collection, but the plants agree in other respects.

Diplazium subintegrum Holttum sp. nov.

Caudex brevis erectus. Stipites ad 80 cm. longi, basin versus squamis brunneis nitidis integris ad 1.5 cm. longis 2 mm. latis acuminatis vestiti, cetera nudi, straminei. Lamina pinnata, ad 70 cm. longa et 40 cm. lata, pinnæ ad 16-jugatæ; apex laminæ basin versus lobatus, cetera more pinnarum serratus. Rachis supra sulcata, in sulco minute papillata, subtus nuda. Pinnæ sub-basales maximæ (infimæ leviter breviores, non deflexæ), petiolutatæ 8 mm., ad 24 cm. longæ et 2.5 cm. latae, basi cuneatæ vel rotundatæ, margine serratæ, apice acuminatæ; textura subcoriaceæ; colore supra atrovirides, subtus pallidæ. Costæ subtus squamis linearibus brunneis paucis munitæ, cetera nudæ; venæ prope costam furcatæ, ramus acroscopicus simplex, ramus basiscopicus 1- vel 2-furcatus. Sori semper in venula acroscopica, e costa ⅔ – ¾ ad marginem, sedentes; rami venulæ basiscopicæ interdum soros breves ferentes. Indusia simplicia vel duplicia, lata, persistentia.

Type. Pahang, Sungei Burong, Cameron Highlands, 5000 ft. S.F.N. 31350 (Holttum), in Herb. Singapore. Frequent in forest.

Other specimens.—Pahang: Cameron Highlands, 4800 ft. S.F.N. 23338 (Holttum); G. Berembun, Ridley 13969; Fraser's Hill, 4000 ft. S.F.N. 8818 (Burkill and Holttum), 21539 (Holttum), G. Hose 15. Perak: The Cottage, Taiping, H. D. Hervey s.n. 1889; G. Batu Puteh, summit, Wray 314. Selangor: Bukit Kutu, 3,000 ft. Ridley 7844.

This species is allied to *D. Prescottianum* (Wall.) Moore, but differs constantly in the pinnæ never being in the least degree lobed nor auriculate at the upper base. It is frequent in the mountain forests on the Main Range, at least at Fraser's Hill and Cameron Highlands and is so constant that I cannot but regard it as a good species, though intermediates between it and *D. Prescottianum* appear to exist at lower altitudes. *D. Prescottianum,* founded on a specimen from Singapore, needs more study in the field. There are some specimens from Ginting Simpah (alt. 1500 ft.) which seem to connect it with *D. subintegrum;* but as *D. Prescottianum* has been rarely collected in true lowland forest we still have no proper understanding of its range of variation.

Diplazium velutinum Holttum sp. nov.

Caudex brevis erectus. Stipites plerumque 20 cm. longi, fusci, omnino pilis mollibus pluricellulis brunneis, basin versus squamis angustis nigris integris vestiti. Lamina anguste deltoidea, ad 25 cm. longa et 15 cm. lata, bipinnata. Raches pilis brunneis omnino dense velutinæ, squamis angustis nigris paucis intermixtis. Pinnæ liberæ 12-15-jugatæ. Pinnæ subbasales maximæ, ceteræ sensim reductæ, superiores in apicem brevem lobatum laminæ confluentes. Pinnæ maximæ ad 8 cm. longæ et 3 cm. latæ, plerumque 6 cm. longæ et 2 cm. latæ, subsessiles, e basi lata ad apicem sensim angustatæ; basin versus pinnatæ, apicem versus ad alam angustam lobatæ. Pinnulæ liberæ paucæ, ceteræ ad rachin plus minusve adnatæ. Pinnulæ vel lobi maximæ oblongæ, leviter obliquæ, margine serratæ vel lobatæ, apice rotundatæ, textura chartaceæ. Venulæ in pinnulis ad 7-10-jugatæ, simplices vel furcatæ. Sori e costa ½ – ⅔ ad marginem in venulis sedentes : in venulis furcatis ramum acroscopicum solum occupantes. Indusia sororum infimorum duplicia, cetera simplicia.

Type.—Pahang, Cameron Highlands (47th mile, Telom Rd) 4800 ft. S.F.N. 31221 (Holttum), in Herb. Singapore. Frequent in shady forest by rocky stream. Also Cameron Highlands, 4800 ft. S.F.N. 23428 (Holttum).

This species is closely related to *D. tomentosum* Bl., and there are a few specimens which are intermediate between the two species, but it differs very strikingly from typical *D. tomentosum* in the following characters : the pubescence on stipe and rachis is more abundant, and the lower pinnæ are always pinnate at the base, even in fronds of moderate size. The most extreme form, represented by one plant, has the pinnules lobed half way to the costa. In most cases the pinnules are serrate, the upper base tending to be auriculate.

D. tomentosum is a common fern of lowland forest in the Malay Peninsula, and there are a large number of collections in the Singapore herbarium. The range of variation is considerable, and in some cases the lower pinnæ are dissected to the costa. This extreme form is connected with *D. velutinum* by a few specimens from altitudes of about 3000 ft. In view of the constancy of *D. velutinum* in the neighbourhood of Cameron Highlands, I regard it as a mountain derivative of *D. tomentosum;* the intermediate specimens are possibly hybrids.

D. velutinum grows in the wettest and shadiest mountain forest, near streams.

I have to thank Dr. Carl Christensen for examining specimens, and for suggesting the name *velutinum*.

Dryopteris brunnea (Wall.) C. Chr. var. *glabrata* (Clarke).

Ching places this species in the genus Thelypteris (Bull. Fan. Mem. Inst. **6:** 272. 1936), in which he is doubtless right, but I am not yet in a position to segregate the Malayan species of this genus. The object of this note is to record the collection of the var. *glabrata* at Cameron Highlands, alt. 5000 ft. (Holttum s.n., May 1936). The specimens are small, but clearly referable here. The solitary plant seen was growing among rocks beside a stream in a recently made clearing. *D. oppositipinna* (see below) is clearly allied, but is much smaller with most of the pinnæ broadly sessile.

Dryopteris crenata (Forsk.) O. Ktze.

This widely distributed species has recently been collected for the first time in the Peninsula, on limestone at Gua Teja in Kelantan (S.F.N. 29682, Henderson).

Dryopteris dissecta (Forst). O. Ktze.

The first recorded collection of this species in the Malay Peninsula is Holttum 31292 from Cameron Highlands, alt. 5000 ft. The plants were found growing on the banks of a stream in shady forest. They are large, and agree with some Philippines specimens. They have the general aspect of Tectaria. For a note on this species *see* C. Christensen in this Bulletin, Vol. 7, p. 253.

Dryopteris glandulosa (Bl.) O. Ktze Rev. Gen. Pl. **2:** 812. 1891.

Aspidium glandulosum Bl. Enum. 144. 1828.

Dryopteris iridescens v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI: 11. 1913.

Dryopteris malayensis C. Chr. Vid. Selsk. Skr. VII. **10:** 171, nota. 1913.

It appears to me that by the rules of nomenclature Christensen was wrong in transferring *Polypodium glandulosum* Desv. to Dryopteris (see Index Suppl. 33. 1913), when the name *D. glandulosa* was already occupied by Blume's species; the new name *D. malayensis* was therefore unnecessary. I have examined the type of *D. glandulosa* (Bl.) O. Ktze at Leiden, and I am of opinion that certain Peninsular ferns, which I had noted as being identical with *D. iridescens* v.A.v.R. are referable to this species. From description, it appears to me likely that *D. excrescens* Copel, and possibly also *D. Bartlettii* Copel. fall also within the range of variation of the species.

Blume's specimen at Leiden has the lower surfaces very uniformly glandular, with very short hairs on the veins, the upper surfaces uniformly appressed-hairy. Among Peninsular specimens the pubescence of the upper surface is very variable, even on the same plant; fertile fronds may be hairy when the

sterile are almost glabrous. Characters of pubescence can therefore not be relied upon in this species. A character which seems to be uniform and distinctive is the presence of spherical yellow glands on the sporangia; these glands are similar to those on the lamina. In the subgenus Abacopteris, the sporangia are nearly always setose or glandular in some characteristic way. Occasionally neither setæ nor glands are present; I have noted that this is the case in *D. lineata* (Bl.) C. Chr.

The Peninsula ferns of *D. glandulosa* are all of recent collection, and with one exception are from Pahang; there is also a specimen from Patani in Lower Siam. The duplicates of the specimens have been distributed variously as *D. lineata, D. malayensis* and *D. iridescens.* Older collections named and distributed as *D. glandulosa* are mostly *D. mirabilis* Copel. (*see* C. Chr. in Gard. Bull. S.S. **4:** 391. 1929). The specimens are as follows:

Malay Peninsula.—Negri Sembilan: Ulu Bendul, Holttum 9886. Pahang: Base of G. Senyuin, Henderson 22289; K. Tembeling, Holttum 20533; Ulu Sungei Merapoh, Md Nur 11938; Tembeling, abundant near stream, Holttum 24702.

Sumatra.—Mentawi Islands: Siberut, Boden Kloss 13087.

Siam.—Patani: Banang Sta, Eryl Smith 1858.

Dryopteris lineata (Bl.) C. Chr. Ind. Fil.

Aspidium lineatum Bl. Enum. 144. 1828.

As this species has been confused with *D. glandulosa,* the specimens regarded as true *D. lineata* are enumerated below. *D. lineata* is clearly distinct in the absence of glands on the lower surface of the pinnæ, the absence of hairs on the upper surface, the somewhat pustular nature of the surfaces, the upper base of the pinnæ strongly auricled, the pinnæ almost entire. In the Peninsula the species has only been found in the neighbourhood of Cameron Highlands (on the Main Range, near the Perak-Pahang boundary). All specimens of which the altitude is given were collected in the mountains; but a specimen from Patani in Lower Siam was collected at a low altitude. The plants grow on rocks by forest streams. The specimens are:

Perak.—Gopeng, King's Collector 497; no locality, Scortechini. Pahang: Telom, Ridley 13997; Cameron Highlands, 4800 ft., Holttum 23362 and s.n. Patani: Banang Sta, 70 m., in earth on rock in large stream, Eryl Smith 2026; near Betong, on log in stream, 220–270 m., Eryl Smith 2027.

Dryopteris multisora C. Chr. Gard. Bull. S.S. **7:** 241. 1934.

This species, described from Mt. Kinabalu, B.N. Borneo, has been collected also in the Malay Peninsula, at Cameron Highlands, Holttum 23345, 23437 It belongs to a group of species which are only found in mountain forests.

Dryopteris oppositipinna v.A.v.R. MS in Herb. Bog.

Phegopteris oppositipinna v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XVI: 24 1914.

The type of this species was collected by Matthew on Mt. Singgalang, Sumatra (no. 518). I found it for the first time in the Malay Peninsula at Cameron Highlands (Holttum 23261), on wet rocks by a small stream in a rather open place at 4000 to 4,500 ft. altitude. The peculiar almost opposite broadly sessile pinnæ are very distinctive; the lower surfaces of rachis, costæ and lamina bear numerous short stiff pale erect hairs; similar hairs are also sometimes borne by the sporangia. There is no trace of indusium.

Dryopteris Parishii (Hk.) O. Ktze Rev. Gen. Pl. **2:** 813. 1891.

Nephrodium Parishii Hook. Spec. Fil. **4:** 131, t. 260. 1862.

Ridley does not record this species as occurring in the Malay Peninsula, but it was collected by Curtis at Langkawi (Nov. 1889), in crevices of limestone rocks; it has since been found on the mainland, in Perlis, at Bukit Lagi (Corner and Henderson 22876, 23135). Plants were brought to Singapore, and cultivated in pots under glass. The fronds died down periodically; the plants were then dried off and rested until new growth began. The resting habit appears to be obligatory in this species. The same is true of the allied *Dryopteris chupengensis* (Ridl.) C. Chr. Plants from the type locality were brought to Singapore by Messrs. Corner and Henderson in 1929, and grown in pots alongside *D. Parishii*. The two species are so closely similar in form of frond that I thought at first that *D. chupengensis* might be only a young stage. The two remained distinct however, and grew side by side for about three years. The largest dimensions of lamina attained by *D. chupengensis* under cultivation were 10 by 9 cm.

Dryopteris polita Rosenst. Fedde Report. **13:** 218. 1914.

A record of the occurrence of this species in the Peninsula was made in this Bulletin, Vol. 7, p. 252. It has been found only at Cameron Highlands (Holttum 23451), and was distributed as *D. sparsa*. I have seen the Leiden duplicate of the original collection of *D. polita* (Batakerland, F. Winkler; Rosenst. Fil. sumatr. exsic. 178); it is clearly the same as the Peninsula collection above cited.

Dryopteris pseudocalcarata C. Chr. Ind. Suppl. III: 95. 1934.

Aspidium ciliatum Wall. 1828 (nomen); *Nephrodium* Clarke Trans. Linn. Soc. Bot. **1:** 514. 1880 (non Desv. 1827).

Lastrea calcarata var. *sericea* Ridl. Journ. Mal. Br. R. Asiatic Soc. **4:** 65. 1926.

This species is very distinct from *D. calcarata*. It is common on mossy rocks beside mountain streams in the Peninsula, but does not occur in the lowlands; it has not been found in the south of the Peninsula.

Dryopteris sparsa (Ham.) O. Ktze Rev. Gen. Pl. **2:** 813. 1891.

The only specimen of this species I have seen from the Malay Peninsula is Holttum 25303 from Sungei Sengam, Perak, alt. 3500 ft., on rocks and damp ground near stream, in forest. This specimen is near var. *nitidula,* but the segments are more rounded than in Beddome's illustration. The Sungei Sengam is a small stream on the Perak side of the main range, just below the road up to Cameron Highlands. Ridley quotes a specimen of Matthew's (at Kew) from Maxwell's Hill.

Dryopteris stipellata (Bl.) O. Ktze Rev. Gen. Pl. **2:** 813. 1891.

Aspidium stipellatum Bl. Enum. 152. 1828.

I have examined Blume's specimen at Leiden, and find that some specimens from the Peninsula agree with it. The species is rather abundant by streams in shady valleys at Cameron Highlands; the young unexpanded fronds are covered with mucilage, through which the prominent pale aerophores appear. The surfaces beneath are glabrous, not glandular. A characteristic feature is the sudden narrowing of the apices of the pinnæ. The specimens at Singapore are:

PERAK: King's Collector 6345, 7174 (distributed as *D. heterocarpa*). PAHANG: Cameron Highlands 4800 ft. Holttum 23352. JOHORE: Gunong Muntahak, 600 ft., Holttum 19923.

Hymenophyllum exsertum Wall. Hook. Spec. Fil. **1:** 109, t. 38A. 1844.

This species has not hitherto been recorded as occurring in the Peninsula. The following specimens appear to belong to it; the indusia tend to be narrowed to the apex and entire, but there is much variation, and the sori are often aggregated in the apical portion of the frond. PAHANG: Gunong Tahan, Holttum 20738; Fraser's Hill, Holttum 21569.

Hypolepis bivalvis v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XVI: 19. 1914.

Christensen identified a specimen from G. Tahan as this species; I find that other specimens are also referable to it. All have been distributed as *H. tenuifolia.* The type of *H. bivalvis* is from G. Sago, Sumatra. Peninsula specimens are characterised by the presence throughout of viscid glandular hairs; in herbarium specimens these hairs are dried and their viscid character lost. The species has only been found in open places on mountain ridges.

PAHANG: G. Tahan, 6000 ft. Holttum 20763; Fraser's Hill, 4000 ft. Burkill and Holttum 8498, Holttum s.n. 1923, Eryl Smith 817, G. Hose 7.

Leptochilus decurrens Bl. Enum. 206. 1828.

This species is placed in *Campium* by Copeland (Phil. Journ. Sci. 37; 351). In his key to the genera concerned in the paper quoted, Copeland gives as a distinction between Campium and Leptochilus that the former has a creeping terrestrial rhizome, the latter being scandent or epiphytic. It may be interesting to record that I collected at Cameron Highlands a number of plants of *L. decurrens* (Holttum 23546) the rhizomes of which were scandent to the extent of at least one metre from the ground, on small trees by a stream in shady forest.

Leucostegia immersa (Wall.) Pr. Tent. 95, t. 4, f. 11. 1836.

This species has not been recorded as occurring in the Peninsula. There is a specimen in the Singapore herbarium, from Gunong Tahan (Ridley 16088).

Lindsaya javanensis Bl. Enum. 219. 1828.

L. flabellulata var. *gigantea* Hk. Spec. Fil. **1:** 211, t. 63C. 1846.

L. tenera var. *gigantea* Holttum Gard. Bull. S.S. **5:** 65. 1930.

Dr. O. Posthumus has called my attention to this species, and through the courtesy of Prof. Dr. H. J. Lam I have received a photograph of the type. I believe that it is identical with Hooker's variety above cited, of which I have seen the type at Kew. In my paper on the species of Lindsaya in the Malay Peninsula, I maintained this fern doubtfully as a variety of *L. tenera.* I believe that it is quite distinct; it should therefore bear Blume's name.

Lindsaya lucida Bl. Enum. 216. 1828.

L. Lobbiana Hk. Spec. Fil. **1:** 205, t. 62C. 1846. Holttum Gard. Bull. S.S. **5:** 61. 1930.

I have examined the type of this species at Leiden, and I can see no distinction from *L. Lobbiana* Hk., the type of which also came from Java. The Peninsula plants hitherto called *L. Lobbiana* are now therefore referred to *L. lucida;* there is however some possibility that they are distinct from the Java species.

Lindsaya nitens Bl. Enum. 217. 1828.

L. recurvata Wall. Hk. Spec. Fil. **1:** 222, t. 70A. 1846. Holttum Gard. Bull. S.S. **5:** 66. 1930.

I have seen the type of *L. nitens* at Leiden, and find that it is indistinguishable from *L. recurvata;* Blume's name should therefore be adopted for the species. The Leiden specimen has simply pinnate fronds, the lower pinnæ somewhat recurved and their upper edges incised.

Lindsaya nitida Copel. Phil. Journ. Sci. **6c:** 138, t. 21. 1911.

L. integra Holttum Gard. Bull. S.S. **5:** 67. 1930.

I have seen the type of Copeland's species in Brooks's herbarium at the British Museum. It is bipinnate, but in other respects agrees with my *L. integra*. Brooks's specimens was gathered at 3000 ft. on Mt. Penrissen, and it is possible at that this altitude the species grows to a larger size than by the lowland rivers of the Peninsula. Many species of Lindsaya have fully fertile fronds before they are large enough to bear fronds of fully mature size and branching. Christensen in Gard. Bull. **8:** 237 suggests that this species may be identical with *L. nitens* Bl. In my opinion the latter species is quite different, being identical with *L. recurvata* Wall.

Lygodium borneense v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XX : 29. 1915. Holttum, Journ. Mal. Br. R. Asiat. Soc. **6:** 16. 1928.

This remarkable fern, first discovered in Borneo, was collected by Boden Kloss on the Mentawi Islands, off the west coast of Sumatra. The gap in distribution has now to a small extent been filled by the discovery of plants in Johore, by Mr. E. J. H. Corner (Sungei Dohol, Ulu Sedili, Corner 26053). The plants were found in fresh-water swamp forest. This peculiar habitat may be part of the reason that the species has been so little collected. Fresh-water swamp forests are difficult botanical hunting grounds, and have been inadequately explored, a fact which is well shown by several recent discoveries by Mr. Corner.

Microlepia pilosula (Wall.) Pr.

A specimen recently collected at Cameron Highlands (S.F.N. 31293, Holttum) is closely similar to a specimen from Yunnan determined as *M. pilosula* by Mr. R. C. Ching. I have sent a specimen of the Cameron Highlands plant to Mr. Ching, who confirms the identification. The plant was found growing in the bed of a forest stream, under very moist conditions, at about 5000 ft. altitude. Its characteristic feature is the rather stout stiff pale glistening hairs on the rachises and veins beneath. A similar specimen from northern Siam (Doi Sutep, 1250–1400 m., Winit 1212), in the Singapore herbarium, was also found on moist rocks in a stream bed in evergreen forest. This is a great contrast to the dry open habitat favoured by the common *M. speluncæ*.

Nephrolepis barbata Copel. Perk. Frag. 178. 1905.

Christensen has seen the type of this species, and has identified with it specimens from the Peninsula; I am thus able to enumerate the specimens in the Singapore herbarium, which have hitherto been named *N. exaltata*. The species is characterised by relatively narrow fronds (to about 9 cm. wide), often of great length, the pinnæ close, strongly falcate, usually

drying rather pale green. The plants nearly always grow on rocks, or sometimes on trees, their fronds being pendulous, sometimes well over two metres in length.

PENANG : Waterfall, Ridley 7038. PERAK : Bujong Malacca, Ridley 9607; Relau Tujor, L. Wray 2207; Larut, King's Collector 5229, 5220. NEGRI SEMBILAN : Ulu Bendul, Holttum 9820. SELANGOR : Gua Batu Woods, Ridley s.n. Dec. 1896. PAHANG : Tahan River, near K. Teku, Holttum 20807; Gua Tipus, Chigar Perah, crevices in limestone, Henderson 19405.

There are also specimens from Siam.

Ophioglossum simplex Ridl. ex Bower, Nature **64:** 617. 1901.

This curious species, originally reported from Sumatra, has been found on the summit of Gunong Panti, Johore. It was growing on the ground in the shade of a thicket which had grown up on the summit after clearing. This is the first record for the Peninsula.

Osmunda javanica Bl. Enum. 252. 1828.

The first collection of this species in the Peninsula was made by me in the valley of the Sungei Sengam, Perak (Holttum 25302), at about 3500 ft. above sea. The plants were quite abundant in shady forest, on the valley-sides. They are in appearance very like *Cyathea brunonis,* for which reason they may have been overlooked in the past, but when fertile they are naturally quite unmistakable. The very young unexpanded fronds are covered with mucilage, in the manner of Plagiogryria, but there are no aerophores. The pinnæ are articulate, another resemblance to *C. brunonis.* Plants are growing quite well in cultivation in Singapore and have produced spores. It has since been discovered that *Osmunda javanica* is very abundant beside the Telom river at about 3900 ft. alt., growing in large clumps on rocks, and also in the forest near by.

Plagiogyria adnata (Bl.) Bedd. F.B.I. t. 51. 1865.

No record has been made of the occurrence of this species in the Peninsula. There is however a collection of Mr. Ridley's, from Gunong Tahan (Ridley 16002); this was distributed as *Polybotrya appendiculata* var. *subintegra.*

Polypodium albidosquamatum Bl. Enum. 132. 1828.

This species has never been recorded as occurring in the Malay Peninsula. It was collected by Kunstler in Perak, and was distributed as *Polypodium leiorhizon* Wall. The specimen in the Singapore Herbarium is labelled "King's Collector, no. 10703", and bears no exact locality. The species is of wide distribution, and it is rather surprising that it has only once been found in the Peninsula. The Singapore specimen has only fertile pinnæ, which are rather unusually long.

Polypodium grandidentatum (Cesati) Bak. Ann. Bot. **5:** 479. 1891.

P. dilatatum var. *grandidentatum* Ces. Att. Ac. Nap. **7,** 8 : 27. 1876.

This species, allied to *P. Hancockii* (*see* below), appears to be quite distinct. In the Peninsula it is a lowland plant, whereas *P. Hancockii* has only been found at about 5000 ft. *P. grandidentatum* when mature has much larger fronds than *P. Hancockii,* and also differs in having the lower lobes gradually reduced in size, whereas in *P. Hancockii* the lowest lobes are the largest. *P. grandidentatum* was described from a plant from Matang, Sarawak, which I have seen. The species usually grows on rocks, but in my experience has not the stiffly erect habit of *P. Hancockii.*

Polypodium Hancockii Bak. Journ. Bot. 1885 :106.

P. euryphyllum C. Chr. Index.

In the Peninsula this species has only been collected at Cameron Highlands (Holttum 23501); the specimens formerly distributed as *P. dilatatum* Wall. or *P. euryphyllum* are *P. grandidentatum. P. Hancockii* is found on mossy rocks beside small mountain streams at about 5000 ft. altitude, in shady places. The rhizome clings to the rocks and the fronds are erect.

Polypodium insigne Bl. Enum. 127. 1828.

This species has been collected in the Peninsula, but not reported. It is apparently very variable in the width of the pinnæ; in this character Peninsula specimens agree well with the type. The species appears normally to grow on rocks beside forest streams, but two specimens collected at Fraser's Hill were climbing trees to a few feet from the ground. Ridley's specimens were distributed as *Aspidium decurrens.*

PAHANG : Telom River, Ridley 13978; Fraser's Hill, G. Hose 9, Holttum 8789. PERAK : Sungei Sengam, 3500 ft., Holttum s.n. 1931.

Polypodium normale Don, Prodr. Fl. Nepal. 1. 1825.

This species has not yet been recorded as occurring in the Malay Peninsula. I collected it at Cameron Highlands, at 4800 ft., on a tree on the edge of the forest (Holttum 23363). The specimen appears to me quite identical with *P. normale* from Assam, and also with *P. subnormale* v.A.v.R. from Sumatra.

Polypodium malaicum v.A.v.R. Handb. 577. 1909.

Polypodium sessilifolium Hk. Spec. Fil. **4:** 168, pl. 268A. 1863.

The question of the type of this species is a rather difficult one. Hooker in his original description quoted three specimens, but did not indicate a type. The specimens are : Luzon, Cuming

382; Penang, Sir W. Norris; Java, Blume. An inspection of the sheets at Kew indicates that Hooker's figure was drawn from another specimen not cited by him, namely Cuming 222 from Luzon. This figured specimen is on the same sheet at Kew as Cuming 382 and Norris's plant from Penang; both of the latter are very much smaller than the figure, which agrees closely with Cuming 222. Examination of the lists of Cuming's numbers show that Hooker made a mistake in regarding no. 382 as from Luzon; it was actually collected in Malacca, and it is certainly identical with *P. subevenosum* Bak., the type of which is from Penang.

Hooker's description indicates that he included Cuming 222 in his species (he gives the length of the fronds as 3–8–9 inches); in fact, the species is a composite one, including *P. subevenosum* from the Peninsula and a distinct species, represented by Cuming 222, from Luzon. There are clearly two alternatives: either we may regard Cuming 382 as the type of *P. sessilifolium* Hk., in which case that species becomes a synonym of *P. subevenosum* Bak. and a new name is required for the Luzon plant; or we may select Cuming 222 as the type of *P. sessilifolium* Hk., in which case the species is quite distinct, and should bear the name *P. malaicum*. I prefer the latter alternative, more especially as it agrees with the treatment which has usually been given to the species. Christensen refers to the species in this sense in this Bulletin, vol. 7, p. 292, and remarks that a specimen from Kinabalu is identical with Copeland's Pterid. Philip. exsic. 141, distributed as *P. sessilifolium*, and notes the presence on both of setose sporangia. Cuming 222 has not been examined to find out whether it has this character.

My proposal is therefore to regard Cuming 222 as the type of this species, excluding the Peninsula specimens quoted by Hooker (Cuming 382 and Penang, Norris); it is much larger than *P. subevenosum* and most of the veins are forked, with a probable distinguishing character in the setose sporangia.

Polystichum prolificans v.A.v.R. Bull. Jard. bot. Buitenz. III ser. **2:** 170. 1920.

A species of Polystichum is quite common on the large granite boulders in shady gullies on Penang Hill; the same species has been collected in Perak (King's Collector 6258). These plants have been named *P. biaristatum* Bl. (Ridley, Journ. Mal. Br. R. Asiat. Soc. **4:** 61. 1926) I have examined the type of *P. prolificans* (from Sumatra) and find that the Perak specimen is identical; the Penang specimens in the Singapore herbarium are all smaller than the type, but are otherwise similar.

Pteris platysora Bak. Journ. Bot. 1880: 211.

A specimen from Gunong Kerbau (Haniff 14743) in the Singapore herbarium appears to be referable to this species, the

type of which is from Sumatra. The specimen represents a large and handsome plant, quite unlike any other Pteris so far known in the Peninsula. This species is apparently very near *P. insignis* Mett.

Pteris scabripes Wall. Hook. Spec. Fil. **2:** 165. 1858.

The type of this species is Wallich no. 94 from Penang. As stated by Hooker, it is very near the widely distributed *P. cretica* L., and I am not in a position to judge how good its claims may be to rank as a district species. The sterile pinnæ are very close together, so that the frond is often almost flabellate; the edges of the pinnæ are finely serrulate throughout, by which this species is clearly distinguished from the following. The species is rather local in its occurrence, though sometimes fairly abundant. Specimens from the Peninsula are :

Selangor : 15th mile Pahang Track Ridley s.n. July 1897. Penang : Jerantut, Holttum 24791; Tembeling, Holttum 24690. Perak : Upper Perak, growing on rocks, 300 ft., L. Wray Jr. 3699; Telok Pinang, Ipoh, Ridley s.n. Oct. 1898. Kedah : Burau Bay, Langkawi, Ridley 15789; Langkawi, Curtis s.n. Sept. 1890; Foot of G. Raya, Langkawi, Curtis 3381.

Pteris venulosa Bl. Enum. 209. 1828.

It appears probable that the specimens from the Peninsula hitherto referred to *P. pellucida* Pr. are *P. venulosa* Bl. I could not find the type of the latter species at Leiden, but saw several other specimens from Java, with which Peninsula specimens agree, with the exception that most of the latter have fewer pairs of pinnæ, and some have the pinnæ so close as to be almost digitate. In habit, Peninsula plants agree rather closely with *P. scabripes,* with which they have been confused. They differ very strikingly however, in having the margins of the sterile pinnæ entire and slightly wavy or crisped, except towards the apex, where they are broadly and rather bluntly toothed; this contrasts with the pinnæ of *P. scabripes,* which are finely serrate throughout. Peninsula specimens are as follows :

Johore : G. Pulai, Hullett s.n. Aug. 1880; G. Pulai, rocks by the stream, Ridley s.n. Dec. 1905; G. Berhidong, on wet rocks 1,800 ft. by stream, Holttum 10995; G. Pulai, G. A. Best 7721. Negri Sembilan : G. Angsi, 2000 ft. Md. Nur 11582. Selangor : C. Curtis s.n. May 1902. Perak : Larut, 2800–3000 ft., King's Collector 3811; Maxwell's Hill 3000 ft. Scortechini 405 : 444. Penang : Government Hill 2000 ft. Haniff 7590; Hullett s.n. December 1881.

Quercifilix zeylanica (Houtt.) Copel. Phil. Journ. Sci. **37:** 409. 1928.

This species, though of wide distribution, has never been collected on the mainland of the Malay Peninsula. It has been found on the island of Pulau Tioman, where it was collected

at the South Cape, nestling in rocks, by Burkill in 1915 (Burkill 1034).

Rumohra aristata (Forst.) Ching, Sinensia **5:** 50. 1934.

Under *Polystichum aristatum,* Ridley (1926, p. 61) quotes his no. 15966 from Gunong Tahan; this is however *R. puncticulata* (*see* below). The only collections of *Rumohra aristata* known to me from the Peninsula are as follows. In one case plants were found growing on rocks beside the Tahan river at about 500 ft. altitude (Holttum 20805); these were small, but quite similar to specimens from southern China. The other collection (Holttum 24999) was from a more shady position, from rocks beside a small forest stream near the Sungei Sengam, Perak, at about 3000 ft. (just below Renglet); the fronds of this were larger and thinner in texture.

Rumohra puncticulata (v.A.v.R.) Holttum comb. nov.

Polystichum puncticulatum v.A.v.R. Bull. Jard. bot. Buitenz. III ser. **2:** 171. 1920.

I have seen the type of this species, from Sumatra, and I believe that specimens from the Peninsula (also Mount Kinabalu) are also referable to it. It is allied to *R. speciosa* (Don) Ching. The Peninsula specimens are from G. Tahan and G. Kerbau, our two highest mountains. They are : G. Tahan, Ridley 15966, Holttum 20779; G. Kerbau, Haniff 4033.

Stenosemia pinnata Copel. Phil. Journ. Sci. Suppl. II: 146. 1906.

All Peninsula specimens of Stenosemia appear to agree with this species rather than with *S. aurita,* to which they have been previously referred. Typical specimens of *S. aurita* from Java have triangular fronds, the lowest pinnæ largest, and the lowest basiscopic segments longest. In most Peninsula plants the lowest pinnæ are not much larger than the next, and the lowest basiscopic segments of the lower pinnæ are small, the largest ones being at about one-third towards the apex. There is some variation, but the Java form is never found. Stenosemia appears to be confined to limestone rocks in the Peninsula. It is well established in shady rockeries at the Singapore Botanic Gardens, where it grows on old coral and reproduces freely. The type of *S. pinnata* is from Mindanao, and a study of the geographic distribution of the forms of Stenosemia would be interesting.

Tectaria decurrens (Pr.) Copel.

This species has not yet been collected in the Malay Peninsula. The specimens so named by Ridley (1926, p. 79) are *T. crenata* Cav. and *Polypodium insigne* Bl.

Tectaria Keckii (Luerss.) C. Chr. Index Suppl. III: 181. 1934.

Aspidium Luerss. Bot. Centralbl. **11:** 76. 1882.

The type of this species is from "Klang, bei den Gua Batu" I have not seen it, but it seems to me highly probable that it is

the same as *Aspidium amplifolium* v.A.v.R., a common fern of limestone rocks in the Peninsula, formerly referred to *A. subtriphyllum*. It is certainly allied to *A. subtriphyllum*, but is a much large fern. Kehding collected both in the Peninsula and Sumatra, and the locality Gua Batu is probably the same as Batu Caves, near Kuala Lumpur.

Tectaria Maingayi (Bak.) C. Chr. Index Suppl. III: 182. 1934.

For sysnonymy of this species, *see* Holttum in this Bulletin, Vol. 5, p. 207.

Tectaria ternifolia (v.A.v.R.) C. Chr. Index Suppl. III: 185. 1934.

Aspidium v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI: 3. 1913.

The type of this species is a specimen collected by Matthew at Gopeng. The species has since been collected in Pahang, as a locally common terrestrial fern in forest on "Raub Series" rocks. The fertile fronds are produced seasonally, on much longer stipes than the sterile. Specimens seen are: Tembeling, Holttum 24693; Henderson 21682; G. Senyum, Henderson s.n. Ridley quotes a specimen from Pekan as *Aspidium ternatum;* this species has not otherwise been found in the Peninsula, and the specimen is perhaps *T. ternifolia.*

Trichomanes exiguum (Bedd.) Baker, Syn. Fil. 464. 1874.

Hymenophyllum Bedd. F.B.I. pl. 275. 1868.

A specimen (s.n.) gathered by me at Ginting Simpah appears to be this species, which has not hitherto been recorded as occurring in the Peninsula. The plants were growing on a large boulder beside a stream in forest near 2000 feet above sea level.

Trichomanes radicans Sw.

No specimen of this species, even widely interpreted as in Copeland's recent work (Phil. Journ. Sci. **51,** p. 213), has hitherto been found in the Malay Peninsula, the nearest being a specimen from Siam. A recent collection from Cameron Highlands (S.F.N. 23466, Holttum) fills this gap. The plants are small, with fronds to 7 cm. long.

Vittaria malayensis Holttum Gard. Bull. S.S. **4:** 409. Jan. 1929.

Apparently *V. stenophylla* Copel. from Luzon (name published in October 1929) is the same as *V. malayensis;* there is a specimen of Copeland's (Pterid. Philip. exsicc. 122) in the Singapore herbarium and I have compared it with Malayan specimens. *V. malayensis* is not uncommon as an epiphyte on the main range of the Peninsula.

FURTHER NOTES ON STENOCHLÆNA, LOMARIOPSIS AND TERATOPHYLLUM.

By R. E. Holttum.

In this Bulletin, Vol. 5, nos. 9-11 (1932), I gave an account of the above genera, based on all the material then available to me. It subsequently appeared that the bulk of the specimens of "Stenochlæna" from the Herbarium of the Bureau of Science, Manila, had previously been sent to the U.S. National Herbarium on loan and were not with the material I had for study from Manila in 1932. Some of the Philippine collections were represented by duplicates at Buitenzorg, and in the Singapore herbarium, but a great many were not. I was therefore very glad of the opportunity of examining the full Manila collections, which has been possible through the courtesy of Dr. W. R. Maxon of the U.S. National Herbarium and Dr. Quisumbing of the Philippine National Herbarium. At the same time, Dr. Maxon sent me on loan the specimens from the U.S. National Herbarium, which in some cases supplied further information.

The result of the examination of these additional specimens is that I am able to add a few notes about the Philippine species of the three genera, and I am able also to correct a misapplication of the name *Lomariopsis leptocarpa*. My thanks are due to Dr. Maxon and Dr. Quisumbing, and also to the authorities of the herbaria at Kew and the British Museum, where I discovered some further specimens during my leave to Europe in 1934.

This paper contains the new combination *Teratophyllum leptocarpum* (Fée) Holttum.

STENOCHLAENA.

S. fraxinifolia Presl, Epimel. 164. 1849.

The type of this is Cuming 347 from Negros. There is a specimen (including fertile frond) in the British Museum herbarium and another in the U.S. National Herbarium; I can see no distinction from *S. palustris*. The characters mentioned by Presl seem to me of little diagnostic value.

S. juglandifolia Presl, Epimel. 164. 1849.

Lomaria? *juglandifolia* Presl, Rel. Hænk. **1:** 52.

Stenochlæna Milnei Und. Bull. Torr. Bot. Cl. **33:** 38. 1906.

The type of this species is a specimen of Hænke's from Luzon; I have not seen it. In *Epimel. bot.* Presl quotes also Cuming 133 *partim*. Cuming 133 is also quoted under *Stenochlæna scandens* (the species now called *S. palustris*) both by Presl and John Smith (Journ. Bot. **3:** 401).

All the specimens of Cuming 133 which I have seen (in the herbaria of Kew, the British Museum, and Dr. E. B. Copeland) are identical, and are intermediate in character between *S. palustris* and *S. laurifolia.* There are some remarks on the subject in this Bulletin Vol. 5, p. 258. I now find that these specimens agree with *S. Milnei,* a species overlooked when preparing my former paper, the type of which I have examined at Kew. The question therefore arises as to whether *S. juglandifolia* and *S. Milnei* are synonymous.

The principal characters distinguishing *S. Milnei* from *S. palustris* are the broadly rounded bases of the sterile pinnæ, and the width (5 mm.) of the fertile pinnæ. Presl gives the first of these as distinctive of *S. juglandifolia;* as regards the fertile pinnæ he states that they have a broad margin on either side of the narrow costal fertile zone, but he does not give any measurements. Presl may perhaps have had a young fertile frond. These facts, together with Presl's citation of Cuming 133 seem to me sufficient evidence for accepting the identity of the two species in question. The only doubtful point in Presl's citation of Cuming 133 under *S. scandens*; it is possible that this was copied from John Smith.

S. juglandifolia is intermediate in character between *S. palustris* and *S. laurifolia.* When preparing my former paper I was in some doubt how to treat intermediate specimens, and finally referred them to *S. palustris,* as they were clearly not *S. laurifolia,* which is a very well-marked species as compared with the variable *S. palustris.* I think however that *S. juglandifolia* is sufficiently distinctive to warrant specific separation. Its intermediate character is seen in the following points :

	S. palustris	*S. juglandifolia*	*S. laurifolia*
Base of sterile pinnæ	cuneate	broadly rounded	cordate
articulation of pinnæ	complete	partial	not articulate
width of fertile pinnæ	2–3 mm.	5 mm.	7–10 mm.
vascular bundles in stipe	to about 40	intermediate	over 100
spores	tuberculate	irregular broken ridges	parallel ridges

The statement about the spores of *S. juglandifolia* is based on an examination of the spores of Milne 518 (the type of *S. Milnei*); this specimen was referred by Hooker (Spec. Fil. **5:** 251) to *S. laurifolia.*

The known distribution of *S. juglandifolia* is as follows : the Philippines, New Guinea and the Solomon Islands. It therefore corresponds approximately with that of *S. laurifolia* and is within the range of *S. palustris*. It is possible that *S. juglandifolia* represents a natural hybrid between the other two species. The Philippine specimens referred to *S. juglandifolia* are as follows : LUZON. Cuming No. 133 (K, B.M., W, Copel.), Irosin (Mt. Bulusan), Prov. Sorsogon, Elmer 16253 (W, M). Los Banos, Elmer 18242 (Copel., M, W). MINDANAO. Camp Keithley, Lake Lanao, M. S. Clemens 944 (M). Butuan Subprov. Fenix 15907 (W).

S. laurifolia Presl, Epimel. 164. 1849.

I have examined the sheets of Cuming 226 (the type collection) at Kew, and find that glands are present at the bases of the pinnæ as in *S. palustris*. Hooker (Spec. Fil. **5:** 251) remarks on the absence of glands as a character distinguishing this species from *S. palustris;* apparently he failed to observe them. Owing to the broad cordate bases of the pinnæ of this species, the glands are not so obvious as in *S. palustris*. Additional specimens of *S. laurifolia* are :

LUZON. Guintacutan, Tayabas, Foxworthy and Ramos 13170 (M).

MINDORO. Bulalacas, J. Bermejos 1545 (M).

LOMARIOPSIS.

L. spectabilis (Kze) Mett. Fil. Lips. 22. 1856.

Lomaria Kze Bot. Zeit. 1848 : 144.

Lomariopsis leptocarpa Holttum, Gard. Bull. S.S. **5:** 270, not of Fée.

In my paper above quoted I followed Underwood in regarding *Lomariopsis spectabilis* as synonymous with *L. leptocarpa*. Fée's figure of the latter agrees very well in shape of pinnæ with specimens of the former from Java. When however I examined the type of *L. leptocarpa* (Cuming 132), I found it to be a Teratophyllum; it is in fact *T. Williamsii* Und. A close inspection of Fée's figure reveals the articulation of the terminal pinna; inspection of the specimens reveals also the great difference in texture and colour. This being the case, another name is needed for the species of Lomariopsis, and fortunately such a name exists in *L. spectabilis*.

The type of *L. spectabilis* is from Java. I have not seen it, but I have seen a number of other specimens from Java, and I think there can be no doubt of the identity with this species of the specimens quoted in my former paper. I have seen one more Philippine specimen (Mt. Mariveles, Bataan Prov., Luzon, Topping 423). This is fully pinnate, but small.

There are no specimens from the Philippines which equal in size those from Java, and there is an almost complete lack of specimens from the intervening area. The Philippine specimens however are not sufficiently distinct to warrant the founding of a new species. The whole question of the distinction between species in the genus Lomariopsis is a very difficult one, and must wait for much more evidence in the shape of collections and field observations.

L. Brackenridgei Carr. in Seeman, Flora Vitiensis, 373. 1873.

As a synonym to this species should be added *Gymnogramme subtrifoliata* Hook., formerly included by me under *L. oleandrifolia*. I have seen the type of Hooker's species at Kew, and in texture and colour it clearly resembles *L. Brackenridgei* rather than *L. oleandrifolia,* which has very coriaceous fronds of a peculiar brown colour. The type in question is a trifoliate frond of a young plant; its reference to *L. Brackenridgei* is therefore not quite certain, but there is no other recorded species from Fiji to which it could belong. The name *Lomariopsis subtrifoliata* is already occupied for Copeland's Philippine species, so that there is no question of this name replacing *L. Brackenridgei,* which is fortunate, as Hooker's type is from a very young plant, and also the validity of his original description, with two question marks, is perhaps open to doubt.

TERATOPHYLLUM.

T. Clemensiæ Holttum, Gard. Bull. S.S. **7:** 262. 1934.

This species is closely allied to *T. rotundifoliatum* (Bonap.) but differs in the bathyphylls, which are all simply pinnate, and in the narrower fertile pinnæ (about 5 mm. wide). The original specimens were obtained on Mt. Kinabalu, British North Borneo. A further collection from Palawan has now to be reported, consisting of the characteristic bathyphylls only. It is Merrill's No. 862 from San Antionio Bay, Feb. 1903 (Philippine National Herbarium).

Teratophyllum luzonicum Holttum Gard. Bull. S.S. **5:** 297. 1932.

This species was based on a single specimen from Luzon; the material did not include bathyphylls. A relationship to *T. rotundifoliatum* seemed probable, but was not proved owing to the incomplete specimen. Among the further Philippine collections from the herbaria at Manila and Washington which I have since examined are some from the island of Palawan which seem to be referable to this species. They consist of bathyphylls from the youngest stage onwards to sterile acrophylls, all associated together but without fertile fronds; the feature in common with the Luzon plant is therefore sterile acrophylls. It is a little uncertain in this genus to base a

determination of an incompletely known species on one stage alone, and collections of bathyphylls from the type locality of *T. luzonicum,* definitely associated with typical acrophylls, are necessary to give a final proof of identity. I think however that the identity is extremely probable; if it fails, then the Palawan plant must be a new species.

The youngest stages (simple fronds) are shown by Merrill's No. 770. The fronds are closely similar to those of *T. rotundifoliatum* and *T. Clemensiœ* (*see* this Bulletin Vol. 5, p. 285, fig. 37, and Vol. 7, p. 263, fig. 1). The basal lobe is perhaps more pronounced than in the other species. No. 771 shows transition (on the Washington sheet) from the youngest stage to small bipinnate bathyphylls; the latter are up to about 4 cm. long and 1.6 cm. wide, the pinnules obovate, to almost 2 mm. long. No. 773 has both sterile acrophylls and bathyhylls, and in the Kew specimen both are attached to the same rhizome. The bathyphyll on the Kew specimen is large, tripinnatifid (almost tripinnate), the segments as in the small fronds. Foxworthy's specimen has rather large bipinnate bathyphylls. The distinction from the bathyphylls of *T. aculeatum* is the obovate shape of the segments, which are rarely bifurcate.

The sterile acrophylls associated with these bathyphylls agree well with those of the type callection of *T. luzonicum,* the difference being that some of the pinnæ are a little larger. The specimens are :

Palawan (Paragua). E-wi-ig- River, 1700 ft. Merrill 770 (W, M). 701 (K, W, M), 773 (K, W, M). Rio Balsajan, 700 m. Foxworthy 577 (M).

T. leptocarpum (Fée) Holttum comb. nov.

Lomariopsis leptocarpa Fée, Acrost. 69, t. 29. 1845.

Teratophyllum Williamsii Holtt. Gard. Bull. S.S. **5:** 292, with synonyms. 1932.

As mentioned above, I have discovered that *Lomariopsis leptocarpa* Fée, represented by the type Cuming 132, is a Teratophyllum, and is identical with the species later named *Stenochlæna Williamsii* by Underwood. Fée's name must therefore be used, as the oldest. The specimen at the British Museum consists of an adult sterile frond, agreeing in all respects with *T. Williamsii.* No bathyphylls were represented in the collection, for which reason Fée included the species under the heading "frondibus homomorphis". As the shape of the pinnæ is very like that of the pinnae of *Lomariopsis spectabilis* the discrimination of the two species from figures is not easy.

Among the Philippine specimens which I have recently examined are a few which show the early stages and normal bathyphylls more completely. The youngest stage is still not

represented, but there are bathyphylls of only 2.8 cm. long; these show no signs of a dimidiate condition. The small bathyphylls show the same character of narrowly linear ultimate segments as the larger bathyphylls; only the very youngest stages have rather broader segments, still with parallel sides. Nearly all specimens, bathyphylls included, show the pronounced red colour on drying. Additional specimens are :

LUZON. Prov. Bataan, Curran 19152 (M), C.B. Robinson s.n. Aug. 1908 (M), P. T. Barnes 85 (M, W). Apayao subprov. Fenix 28276 (M).

T. aculeatum (Bl.) Mett.

There are a number of further collections from the Philippines, chiefly of bathyphylls, which indicate that this species is typically represented in the Philippines, though there are no very young or fully dimidiate stages.

One collection (Rizal Prov., Ahern's Collector, Forestry Bureau No. 2695) has very remarkable large normal bathyphylls, to 16 cm. long and 8 cm. wide. The general character of the pinnæ is similar to *T. aculeatum*, but there are no other specimens at all comparable in size. It is possible that they represent another species.

AN EARLY TERTIARY RELICT IN MALAYA, EUPHORBIA RIDLEYI nom. nov., descr. emend. (E. SYNADENIUM RIDL.) AND ITS POSITION IN THE LINNEAN GENUS.

By Leon Croizat,

New York.

A singular *Euphorbia* was presented by Ridley (Journ. Roy. As. Soc., Str. Br., No. 61 : 36, 1912) as follows :—

"*Euphorbia Synadenium* n. sp. A shrub about 2 feet tall, stem smooth brownish rather succulent. Leaves alternate oblanceolate spatulate subacute or blunt narrowed to the petiole fleshy, green, nerves invisible, 4 inches long 1½ inch wide, petiole ½ inch long. Inflorescence solitary or in pairs 1 male and 1 female axillary. Male, peduncle ⅛ inch long thick with two short ovate bracts purple pink. Involucre as long as pink lobes 5 thick semiorbicular light green punctate. Glands separate truncate oblong narrowed at the base, apex laciniate pink ten. Flowers numerous. Stamens solitary, filament thickened at the base above filiform surrounded by a fimbriate calyx of narrow white linear lobes about 8, anther cells globose separate. Female involucre smaller subangled with 2 dark pink lobes much shorter not expanded greenish yellow, glands flat incurved laciniate pale green. Pistil solitary surrounded with pale green laciniate calyx, overy subglobose shortly stalked. Styles three subulate not plumed twisted together.

Penang Hill : near the Waterfall : Selangor : Langat.

In rocky woods. I have this curious plant in cultivation in the Botanic Gardens in Singapore.

Baillon described a species of *Synadenium* as *Euphorbia Synadenia* but this has been referred to its genus *Synadenium*, so that the above name will stand."

The description, no doubt, suffers on account of careless typesetting. A carefully edited rearrangement of it (Fl. Mal. Pen., 3 : 180–181, 1924), however, is barely more intelligible to the average taxonomist; the revised description is as follows :—

"*E. synadenium* Shrub about 2 ft. tall. Branches rather succulent, brown. Leaves alternate oblanceolate spathulate sub-acute or blunt, fleshy dark green : nerves invisible; 4 in. long, 1.5 in wide; petioles 5 in long. Involucres solitary unisexual. Male on a peduncle .12 in. long with 2 ovate purple-pink bracts; involucre pink, lobes thick semiorbicular, green. Glands 10 truncate oblong laciniate pink. Stamens

solitary surrounded by a calyx of about 8 white linear lobes. Female involucre smaller with 2 pink lobes, glands flat incurved green. Pistil surrounded by a laciniate green calyx. Ovary subglobose stipitate. Styles 3 subulate. Hab. rocky woods, local, Selangor, Langat (Ridley). Penang Hill near the waterfall (Curtis, Ridley) Native name: *Poko Sesudu Bukit*. I have only seen this plant about 2 ft. tall. Mohammed Haniff reports it as growing to 6 to 8 ft."

In both accounts the terminology is Ridley's own and highly unconventional. So much, of course, does not in itself call for comment or censure, but any one familiar with the genus is puzzled by the mention of 10 glands and of 8 lobes that occurs in the later version. Not only in the species, as described, are the glands twice as many as usual: the apparent quinary symmetry of the cyathium itself is denied. The letter of the document reveals *E. Synadenium* either as not less extraordinary a form than *E. pedilanthoides*, or a downright pathologic case.

Before investigating the species, it is necessary to establish its correct name according to the present Rules of botanical nomenclature. In his original publication, Ridley practically admitted that his name *E. Synadenium* (which clearly referred to the genus Synadenium) was homonymous with *E. Synadenia* Baillon. At that time, it was still customary among many European botanists to regard such a homonym as valid, if the earlier name, as in this case, was transferred to another genus. By the recent change in the Rules of botanical nomenclature, however, all later homonyms are invalid. Ridley's name can therefore stand only if we regard it as distinct from *E. Synadenia*. This raises the nice question of what differences may be admitted as constituting distinct names, and conversely. The Rules are decidedly vague on this matter, but in view of Ridley's tacit admission, and of the fact that the two names can legitimately be regarded as of different gender only, it appears right to regard them as identical. A new name is therefore needed, and is given below. It may also be mentioned that Boissier mistranscribed Baillon's name as *E. Synadenium* in the synonymy of *Synadenium arborescens* (D.C. XV: 1269, 1866); but by Art. 40 of the Rules such a synonym has no validity as a published name. The loss of the name *Synadenium* for the present species is not to be regretted, as the "glands" are far from connate.

The writer stands under deep obligation to Mr. Holttum who kindly consented to send on loan the material preserved in the herbarium of the Botanic Gardens of Singapore (No. 1199, VII. 13. 1916, leg. Mohammed Haniff; s.n., III. 6. 1926, leg. E. Seimund) and arranged for the transmission of live rooted cuttings and detached cyathia in fluid. The description to follow, unfortunately, is still short of the data from the ♀ cyathium, although a nearly ripe capsule is recorded.

E. Ridleyi nom. nov., descr. emend.—Leaves alternate, crowded at the tip of carnose slender twigs, glabrous, up to 21 cm. long, 7 cm. broad; blade oblanceolate to subelliptic, very entire, occasionally sublobate (1 lobule seen on 1 leaf), more or less deeply notched at the rounded apex, when dried thickened at the margin and smooth or obscurely and irregularly veined beneath, mostly tapering from the upper third or fourth to a distinct roundish subwinged petiole up to 3½ cm. long; midrib conspicuous beneath canaliculate above ending in a short stiff deciduous mucro; leaf-stipules 2, minute carnose, irregularly conic, grooved, persisting or not at the slightly upraised leaf-scars. Inflorescence strictly axillary of 1–2 (and more?) variously arranged cymes, mostly bistipulate at base, up to 2.5 cm. long; cyathia unisexual, clustering, on monocephalous short peduncles about 2 mm. long, or single on a peduncle 6 mm. long extended beyond a pair of minute bracts into a pedicel 8 mm. long, or in pairs on a common peduncle 5 mm. long and individual pedicels up to 7 mm. long. Cyme-bracts opposite, free or subconnate at base, carnosule, subquadrangular to broad ovate, mostly apiculate, to 3 mm. long. Cyathium (only ♂ seen in fluid and dissected) up to 11 mm. wide with a very shallow involucre and manifestly deflected (at ca. 45°) nectaria [glands], these about as broad as the involucre itself is deep; cyathium-bracts 2–3 spirally ascending or subopposite, clasping, occasionally exceeding the cyathium, carnose, broad ovate to round triangular, apiculate or entire at apex, keeled or rounded on back, up to 4 mm. long and broad; nectaria [glands] 4–5, contiguous, quadrangular to elliptic, rugulose pitted, shallowly and irregularly crenate at margin, 5–6 mm. long, 3–3½ mm. wide; lobes 4–5 elliptic, denticulate 3 mm. long, 2 mm. wide; ♂ flowers [stamens] numerous in (4–) 5 fascicles; staminodes very numerous, carnosule, spatulate, laciniate cleft, to 4 mm. long. Capsule glabrous, smooth or rugulose, 1.3 cm. wide, 8 mm. long. exserted on a thin stipe 8 mm. long; cocci 3, often unequally developed, discrete, the rounded keel becoming more or less thin-acute towards the recurved end; calyculus irregularly 3–5 lobulate, scarcely 3 mm. broad; styles 3, cleft to base, subulate, entire, spreading. Seed not seen.(1)

(1) *E. Ridleyi* nom. nov., descr. emend. (*E. Synadenium* Ridl., nec Boiss. (sphalm. Baill.)) Frutex diffusus 2–8 ped. altus, ramulis succulentioribus ultimis crassitie calami scriptorii. Foliis alternis subverticillatis carnosis glabris, ad 21 cm. longis, 7 cm. latis, apice rotundatis, oblanceolatis subellipticisve, rarissime sublobatis, emarginatis; petiolo ad 3½ cm. longo; stipulis petiolaribus binis subconicis rimosis minutis deciduis vel ad folii cicatricem subelatiorem persistentibus. Cymis axillaribus ad 2.5 cm. altis; cyathiis monosexualibus pedunculatis pedicellatisve ad 11 mm. latis; nectariis 4–5 contiguis foveolatis, ad 45° deflexis, involucri ambitum aequantibus; lobis 4–5 ellipticis, denticulatis, 3 mm. longis, 2 mm. latis; staminibus multis (4–) 5-fasciculatis; staminodiis plurimis; capsula exserta stipitata ad 1.3 cm. lata; coccis 3, discretis recurvis; calyculo 3–5 lobulato; stylis 3, partitis, subulatis intergris. Semina desiderantur.

Loc. : Penang Hill, near the Waterfall : Selangor, Langat (Ridley). Pulau Rumbia (specimen). An indication that the range might tend to become more circumscribed is apparently given in a note from Mr. Holttum (*in litt.* Aug. 1935) mentioning that the plant was not found at an easy accessible former habitat at Penang, although it was still being reported from the south of Penang Island.

The habit is described as follows by Mr. Holttum (*in litt.*, Febr. 1936) "I recently saw an old plant of the species in Penang; it was scrambling over a large rock in half shade and had reached a considerable length, though the stem was still quite slender". This peculiar habit is observed in several Mexican and Tropical American species.

Plainly interpreted *E. Ridleyi* is a form less remarkable in itself than Ridley's diagnosis suggests. Truly remarkable, however, is this species in floristic and in phytogeography.

The understanding of *Euphorbia* at this hour is still fundamentally what it was in the days of Linnæus. In the opinion of the writer the "genus" is a threadbare net of diverse evolutive phyla artificially connected by a common type of inflorescence (cyathium) which the Linnaean understanding consciously or unconsciously treats as a flower. The sections which attempt to present the countless species of *Euphorbia* as a rational whole use in the majority of the cases imperfect concepts, and uncritically accepted are an hindrance rather than a help to study. The fact that N. E. Brown who enjoyed unsurpassed facilities for studying the Linnæan genus disregards sections altogether in his classic works may be invoked to absolve the writer from the duty of proving his statements at this hour. It is plainly not advisable to abound in citations of modern works which, *e.g.*, introduce sect. *Tenellæ* in the Gangetic peninsula in the wake of *E. dracuncoloides*, or very nearly propose a new section on the strength of the digitate nectaria of *E. clavidigitata* from Burma. For the purpose at hand the sections of Hooker (Fl. Brit. Ind. V : 245–246, 1890) are as good as any.

Hooker accepts (o.c., l.c.) :

Sect. I.—*Anisophyllum* with subss. *Elegantes*, *Hypericifoliæ*, *Chamæsyceæ*.

Sect. II.—*Euphorbium* with subss. *Tirucalli*, *Dicanthium*, *Rhizanthium*.

Sect. III.—*Tithymalus* with subss. *Galarhœus*, *Esula*.

The principles of a sound classification of the Linnæan genus were perfectly understood by Roeper (En. Euph., 1824), who emphasized the faculty peculiarly inherent to *Euphorbia* to suppress and to shorten axes (o.c., 28 *et passim*). It may be that

the Enumeratio Euphorbiarum is a juvenile work weak in taxonomic understanding: the fact stands that Roeper had a sounder grasp of the *nature* of *Euphorbia* than Boissier and other well-known botanists, and one may regret that Roeper failed to present the monograph of the genus on which he was known to work (Ch. des Moulins in notes to *E. Milii*, Bull. Hist. Nat. Soc. Linn. Bordeaux I: 27, 1826).

Judged as *natural* groups in the light of Roeper's basic premises *Anisophyllum* and *Tithymalus* have a value that beyond comparison exceeds that of *Euphorbium*. In *Anisophyllum* the main axis aborts immediately above the first pair of leaves, and, therefore, may be technically described as indefinite. The species of the section are all harmonious in the sense of evolution: their development can take place only from buds in the aborted main axis, which simple fact accounts for their axial arrangement, habit and interpetiolar stipules. In *Tithymalus* the main axis develops and is definite, to say ends with a terminal cyathium. The sections lacks stipules and has fundamentally alternate leaves at the axes that are not immediately flower-bearing. Any one who has worked with *Euphorbia* recognizes *Anisophyllum* and *Tithymalus* at sight, for, it has been noticed, they are *natural* groups. The subsections need not be discussed at present.

Euphorbium covers *Tirucalli, Diacanthium, Rhizantium.* The last may be disregarded here. It probably includes regressive and depauperate forms, or highly specialized species from different evolutive phyla and, appearances to the contrary, has never been fully explored. *Tirucalli* has axes that are definite precisely as are those of *Tithymalus*. The main stem evolves freely and the floriferous axes end with a cyathium surrounded by a pseudo-umbel of more or less long-pedunculate and long-pedicelled cyathia. The fact that some species of the *Tirucalli* of common understanding have stipulate leaves may not be discussed even briefly at this hour: suffice it to establish that *Tithymalus* and *Tirucalli*, naturally interpreted, stand on the same phylogenetic and systematic line. *Diacanthium* abhors *Tirucalli*. Its axes are indefinite, not carrying true terminal cymes (pseudo-umbels). Its prickles are spinescent aborted axes prescisely matching those observed in *Rosaceæ, Rhamnaceæ, Rutaceæ*, etc., and not relicts from a ternate foliar verticil or from lobes and auricles at the base of the blade. In brief: *Tirucalli* and *Diacanthium* are "classified" under one section for no better reason than their being succulent.(1)

Concluding: *E. Ridleyi* can not be a *Tithymalus, a Diacanthium* or a *Tirucalli*, and still less an *Euphorbium* which *sectio ineptissima* is wholly an horticultural figment. *E. Ridleyi*

(1) The issues that here must be briefly outlined in order to define the position of *E. Ridleyi* will be treated in detail in a coming publication.

naturally falls in with certain species of sect. *Goniostema*, a section which so far has not been known to exist in Asia.

The *Goniostema* species with which *E. Ridleyi* has affinity are those that Boissier describes (D. C. Prodr. XV 2 : 77, 1862) as having *stipulas indivisas* (typ. *E. pyrifolia*). The species which Boissier lists *stipulis verticalibus cristæformibus* (o.c., 78; typ. *E. leuconeura*) have nothing to do with the true *Goniostema*, Their affinities wholly lie in the direction of the group represented by the so-called *E. splendens*(1). Denis correctly shifts them (Euph. II. Austr. Afr., 72, 1921) there, unfortunately, however, offsetting this pertinent change with the inclusion of *E. orthoclada* under *Goniostema*. *E. orthoclada* has definite axes and pseudoumbels, and belongs with *Tithymalus*.

Compared with the species of *Euphorbia* of the Malaysian, Indochinese and Australasian domain *E. Ridleyi* is found naturally to agree only with *E. epiphylloides*, an endemic of the Amdaman Islands (v.v.) which has no place with the *Tirucalli* species among which it has so far been listed. The peculiar flattened stems of *E. epiphylloides* do not alter the basic characters of inflorescence, leaf-stipule and habit, *sensu lato*, that make of it an outspoken *Goniostema*. *E. plumerioides* with range from the Philippines to Java belongs to *Tithymalus*. Two species respectively from the Straits of Torres and from Queensland and New Zealand, *E. corynoclada* and *E. glauca* abhor *E. Ridleyi*. The former, as Manson Bailey appears to claim correctly (Queensl. Fl., V : 1400, 1902) is close to *E. aphylla* which is a Canarian endemic of the *Tirucalli* description. The latter is a strand-species which is similar to the *Euphorbia* species from the Macaronesian domain included by Boissier in *Tithymalus* subs. *Pachycladæ*.

There is a bare possibility that *E. Ridleyi* is allied with *E. Cleopatra* (n.v.), from New Caledonia. This island, and its archipelago, are a domain of extraordinary interest for the student of *Euphorbiaceæ*. Regardless, however, of a possible connection with *E. Cleopatra* the affinities of *E. Ridleyi* are in the direction of species from Madagascar and the groups of islands in the Indian Ocean. Thus *E. Ridleyi* and *E. epiphylloides* stand at the eastern, *E. pyrifolia* at the western pillar of a collapsed bridge : they brood over a continent that has been engulfed by the Indian Ocean. In the truest sense of the word they are relicts, which is it proper to designate as Gondwanic relicts.

Gondwanaland up to the beginning of Tertiary times connected Africa with Malaysia and Australia, and sound evidence has been unearthed to the effect that at the same time or

(1) Bojer's binomial, *ex* Hooker, owes its success to the circulation of pl. 2902, Bot. Mag. 1829, but loses precedence to *E. Milii* Ch. d. Moul., Bull. Hist. Nat. Soc. Linn. Bordeaux, I : 27–30, *cum ic.* 1 *e.* 1826. Des Moulins' binomial is far from being the *nomen nudum* which it is generally supposed to be.

shortly before Africa was connected with America (1). Under the standpoint of palaeogeography a relationship between the life-forms of Madagascar and Malaysia, at least as far east as the Wallace's Line, is not only posible but probable. Botanically the evidence in favour of such connection is quite strong. Only to mention one family, *Euphorbiaceæ,* have identic genera in Tropical America and in Africa (cfr. Lanjouw, Euph. Surin., 79–84, 1931). The connection established between the Malagasy and the Malaysian domain by the species of sect. *Goniostema* has just been recorded. Merrill pointedly remarks (Ess. Geob., 247, 1936) that the flora of Polynesia is essentially Malaysian. The same phyla have "tapered" to closely allied genera in distant continents (cfr. *Richeria* and *Richeriella; Baccaurea* and *Aporosella*). The phylum of *Euphorbiaceæ* is not holartic : it harks back, it seems, to forms the beginning of which must be sought at the Permo-Carboniferous glaciation, and its axis of migration is roughly parallel to the equator of to-day in a west-to-east direction. The migration of the holartic phyla is roughly perpendicular to the equator, and confusion need not be made between the two main streams of diffusion of plant-life.

The persistency of isolated species at extreme points of a geologic plant-domain is not surprising. Van Steenis remarks (Bull. Jard. Bot. Buitenz. XIII : 393, 1935) that Malaysia from the Cretaceous on has practically always been wholly within the tropical zone. In contrast to the widespread assumption life does not *naturally* exhibit an aptitude to change. It reacts against the forces in the ambient, and ultimately dies or migrates or is transformed when the pressure of the ambient becomes too strong. It would seem, lastly, that the more a plant-group has been capable of changing in the past the more it is apt to change in the future. *E. Ridleyi* is an archetype lingering in a favoured area, which is matched by *E. epiphylloides* and, if the writer be correct, by certain genera of Malaysian ferns. It is curious to notice that an analogy appears to exist between the rhythm of plant-life at one hand and the laws of motion at the other.

(1) The bibliography on this subject vastly exceeds the limit of space allowed to these cursory notes. The reader may consult Th. Arldt, Handbuch der Paläogeographie, 2 vols., 1919–1922; J. W. Gregory, The Rift Valleys and the Geology of South Africa, 1921; A. P. Coleman, Ice Ages Recent and Ancient, 1926; A. de Toit, Geology of South Africa, 1926; (T. H. Goodspeed, edit.) Essays in Geobotany in honor of W. A. Setchell, 1936. A masterful study on polar shifts is D. Black's, Palaeogeography and Polar Shift, Bull. Geol. Soc. China, X, 1931.

PALMÆ MALESICÆ.

VI.—Notes on Some Dæmonorops of the Section CYMBOSPATHÆ.

By C. X. Furtado,

Botanic Gardens, Singapore.

1. Summary and Introduction.
2. Systematic Difficulties Inherent in the Species of the Section.
3. Good and Ample Collections are Needed.
4. Specimens should be Adequately Numbered.
5. Data to be Noted on the Field-labels.
6. Distribution of Sex in the Individual Plant and Spadix.
7. Sex of the Clump.
8. Is Dæmonorops Parthenogenetic?
9. Systematic Notes.

1.—Summary and Introduction.

This paper embodies some results obtained in the course of my study of rattans belonging to the genus *Dæmonorops* of the section CYMBOSPATHÆ. My inquiry is based mainly on the herbarium material, but I have also had opportunities of studying some few species in the field and the results of these also are embodied herein. Both these investigations have strengthened my previous conviction that much of the vagueness hitherto observable in the specific circumscription of many species is due to the inadequacy of the herbarium material coupled with its faulty numbering. These two aspects of the subject I have already touched on in previous papers (cf. Gard. Bull. S.S. VIII, 1935, pp. 241–261, and 339–367). But so important is this matter to the systematist that I make no apology for reverting to it here. If the systematist is to clear up the status of the doubtful species and to devise a simpler means of classifying rattans, a large series of herbarium specimens, prepared according to the needs of the systematist, becomes an indespensible preliminary, and part of this preliminary is the issuing of detailed instructions to plant collectors.

The opinion that normally the genus *Dæmonorops* is monœcious with unisexual spadices, is herein shown to be fallacious. All the specimens so far seen go to support Beccari's contention that the genus is diœcious, the male-like acolyte of the female being a neuter flower. In some species, however, of the section CYMBOSPATHÆ the male plant seems to play no part in the development of the fruit, the female plant itself being apparently parthenogenetic. Further observations are needed to verify this apparent parthogenesis in *Dæmonorops*.

My inquiry into the systematics of the Malayan species of *Dæmonorops* of the section herein treated was much simplified by obtaining on loan authentic specimens of Griffith's species from the herbarium of the Royal Botanic Gardens, Calcutta, and some critical specimens from the herbarium of the Botanical Gardens, Buitenzorg. It is my pleasant duty here to record my indebtedness to the respective Directors, of the two institutions named, for their kindness in allowing the loan. The results obtained may be summarised as follows :—

(1) **New Species:** (*a*) *D. angustispathus* and *D. Curtisii* from the Malay Peninsula; and (*b*) *D. javanicus* from Java.

(2) **New Records:** (*a*) for the Malay Peninsula : *D. melanochætes;* (*b*) for Borneo : *D. hygrophilus* (doubtful) and (*c*) for Sumatra : *D. hygrophilus*, *D. Lewisianus* and *D. pseudosepal.*

(3) **New Interpretations:** *D. intermedius* (Griff.) Mart., *D. Lewisianus* (Griff.) Mart., *D. malaccensis* Mart., and *D. monticolus* (Griff.) Mart., all of which are indigenous and endemic in the Malay Peninsula. These interpretations have been based on the authentic specimens, (when available in the Calcutta herbarium), as well as on the description and the drawings published by Griffith.

(4) **New Synonyms** (Species newly reduced to the synonymy) : *D. aciculatus* Ridl., *D. bakauensis* Becc., *D. carcharodon* Ridl., *D. congestus* Ridl., *D. imbellis* Becc., *D. intermedius* var. *nudipes* Becc., *D. malaccensis* Mart., *D. microthamnus* Becc., *D. monticolus* var. *pinangianus* Becc., *D. petiolaris* Mart, and *D. Schmidtianus* Becc. The possibility of *D. fissus* var. *cinnamomeus* Becc. being identical with *D. hygrophilus* is indicated.

2.—Systematic Difficulties Inherent in the Species of the Section.

Anyone who has attempted to study the rattans of the genus *Dæmonorops,* belonging to the section CYMBOSPATHÆ, will at once realise that, although the species can be classified readily into definite groups, to make a clear cut delimitation between the different members constituting each group, is a different, and rather a difficult, matter. Beccari, in spite of his prolonged studies, was unable to overcome this difficulty, and therefore he ventured a suggestion, according to which each one of the groups would be regarded as a collective species (synspecies), the different individual members of the groups being treated as so many sub-species. (Calc. Ann. XII, 1911, p. 28, footnote).

No doubt a chief reason why the separation of the species is a difficult task is the very close relationship existing between them; in many cases no conspicuous and easily describable diagnostic characteristics distinguish one group from another.

But perhaps a reason of no less importance is our ignorance of the full amount of variation in each species: for the species of the section CYMBOSPATHÆ vary greatly in regard to the size of the leaflets, spathes, and spadices; and also to a certain extent in regard to the nature and arrangement of bristles or spines on the spathes and leaf-sheaths in different parts of the same plant, or else at different ages, or under different ecologic conditions. Moreover, the material available in the several herbaria of the world is often inadequate as a source from which to draw reliable distinctions between different but closely related species. While such distinctions are, or at least seem, quite obvious in the field, they cannot be verified in the herbarium on account of the poorness of the material there available.

3.—Good and Ample Collections are Needed.

In order to obviate in their studies complications arising from difficulties in regard to species, systematists have been content hitherto with the expedient of classifying species geographically, and so, of dividing the entire *Dæmonorops* area into several geographic sub-units. Under this expedient they describe as new every find that does not correspond with any species previously described in relation to its respective geographical sub-region or sub-unit. Only when it is quite obvious that a specimen belongs unmistakably to a quite distinct species already defined as inhabiting another sub-region or sub-unit will it be admitted as an old species into the region where it is newly found. While this prodecure had the advantage of throwing some light on the rattan floras of the regions studied, its legitimacy as a form of classification can scarcely be defended, consequently it is high time that a pause should be agreed upon to enable the conception of species to be de-geographized. But to do this thoroughly would entail the critical examination of a large series of material of the "synspecies" from the different regions.

No doubt the first disclosure would be the paucity and insufficiency of the material represented in the herbaria of the world. Next, it would necessitate collectors being asked to contribute towards discovering the true species by striving to show in their collections the extreme variations that occur in the adult forms of the rattans. They should be encouraged to give one number to each individual plant and to include in the principal sets two complete specimens showing the extremes of variability of the individual. If the collectors could be induced to make complete specimens, as recommended in my previous papers (Gard. Bull. S.S. VIII, 1935, p. 242, and 342), much of the present confusion would vanish like a guilty thing or like the furrow cut by a ship's keel in the sea.

4.—Specimens should be Adequately Numbered.

In this connection one cannot emphasize too strongly the importance of numbering rattan specimens carefully in the field. Ridley tried to study the *Dæmonorops* species from the Malay Peninsula without numbering the specimens in the field, and obtained but very poor results. Ridley alludes to his studies in the field in the following remarks made in his *Flora V*, 1925, p. 34 :—

> "These plants vary much in the size of leaflets, spathe and spadix, bristleness and arrangement of spines on the sheaths in different parts of the same plant. Many species have been based on totally inadequate herbarium material. I have seen many of the species wild, often in abundance, and cultivated many of them. Beccari's volume *Ann. Bot. Gard. Calc. XII*, with large photographs of the herbarium specimens is invaluable, though I am by no means agreed as to some of his determinations. Specimens are so bulky and spiny that collectors are apt to bring home mere scraps of the plant which are utterly unreliable. They can only be properly studied in the forests".

A close examination of Ridley's determination of the species of *Dæmonorops* of the Malay Peninsula (cf. my paper in Gard. Bull. S.S. VIII, 1935, pp. 339, 367, and *vide infra*) reveals the fact that the specimens, owing to Ridley's not having numbered them in the field, were often so mixed that Ridley himself could not disentangle them correctly. Naturally, therefore, when coordinating his field observations in the herbarium, Ridley came to several erroneous or misleading conclusions; and but for the specimens collected and numbered according to the system introduced into Malaya by Ridley's successor, Mr. I. H. Burkill, as the Director of Botanic Gardens, Singapore, Ridley's errors in classification and determinations of the *Dæmonorops* species would have remained beyond correction, or anyhow extremely difficult to correct.

This miscarriage of Ridley's long and painstaking studies in the field, coupled with his systematic investigations in the herbarium, should prove to botanical institutions how imperative it is to impress upon the departmental plant-collectors, or upon the collectors of the expeditions supported by them, the real necessity not only for making their rattan collections as complete as possible as directed in my previous notes (Gard. Bull. VIII, 1935 pp. 242 and 342), but also for numbering them adequately in such a manner as to prevent the component parts of one from getting irretrievably mixed with the component parts of another. I am firmly convinced that good specimens, if properly labelled, would also render the systematist less dependent on field notes for their accurate determination.

5.—Data to be Noted in the Field-Labels.

It is evident, from a reading of the several floristic works, that very little information is available about the actual habit of many rattans. The data recorded in the field-notes is likewise so meagre that it often takes one not a step forward. After a thorough study of all the information presently available in the published works, and particularly those carefully noted on the herbarium labels, our knowledge of the habit of certain rattans is still obscure; thus it is difficult to say whether they are solitary or tufted, whether they are long climbing, like *Calamus scipionum,* attaining a length of over 150 feet, or whether they are short, like *Dæmonorops grandis,* or erect or subscandent, like *D. Lewisianus.* From the description available, for instance, one would not imagine that the stems of *D. calicarpus* are very short, being not more than 1–3 feet high and scarcely visible to a casual observer, hidden as they are by long radical leaves, which grow all round the bush and attain a length often many times greater than the actual stem and its leaves together. But if the specimen sent in by the collector, besides being collected according to the necessities of the systematics explained herein, were accompanied by field notes or photographs indicating the habit of the species chosen, then the systematist could get a better conception of the species and might eventually succeed in devising a classification that would render less difficult the circumscription of many a puzzling species.

In the case of tufted rattans, specimens of the radical leaves are not absolutely necessary, the adult leaves are the most important. But if the radical leaves are taken and numbered separately, so as to prevent them being confused with the adult ones, but at the same time to show their relation to the latter, they might help to bring out the characteristics of the species more clearly.

6.—Distribution of Sex in the Individual Plant and Spadix.

There still exists considerable confusion regarding the distribution of sex in the species. In the *Materials II (1907) pp. 173 and 174,* Ridley definitely states that the spadices of *D. angustifolius* are bisexual, a statement he repeats later in *Flora V (1925) p. 36.* In the latter work Ridley notes that he has not seen any specimens of *D. Scortechini* and *D. sepal;* yet in his Key to the species (*p. 35*), he lists these two species with *D. angustifolius* as having bisexual spadices. This is surprising, seeing that Beccari, the author of the two namings, has definitely stated the opposite regarding the sexes of the spadices in the genus *Dæmonorops;* nor has any one else described the species at length; it must therefore be regarded as gratuitous that Ridley should re-define the sex without giving any support-

ing observation. Beccari's remarks on the question seem worth quoting here :

> "As in the *Calami,* the spadices of *Dæmonorops* are always dioecious, though one may sometimes happen to meet with a male spadix with a hermaphrodite flower here and there. It is possible that the female spadices of some CYMBOSPATHAE are cleistogamous—at least, I suppose they may be having observed that certain still closed spadices of *D. fissus* contained ovaries in process of development, which had every appearance of having been fecundated. The closure may however have been more apparent than real, and thus an insect may have been able to penetrate into the interior through the half closed spathes." (Calc. Ann. 1911, p. 2.).

Regarding Ridley's views on the subject, Beccari comments as follows :—

> "Mr. H. N. Ridley (*Mat. Fl. Malay. Pen. II, 1907 p. 171*) says that the spadices of the *Dæmonorops* are usually unisexual, and that male and female inflorescences are on the same stem—a fact which I have never observed. The same author (*l. c. p. 172*) adds that both sexes occur on the same plant : furthermore, he describes the spadix of *D. angustifolius* as having a 'bisexual spadix, male and female flowers on the same spadix in pairs.' Apparently Mr. Ridley has considered as a fertile male flower the neutral or sterile flower which accompanies every female flower on the female spadix in all the species of Dæmonorops I have examined."

After examining several *Dæmonorops* of the section CYMBOSPATHAE cultivated in the Singapore and Buitenzorg Gardens, I can testify to the authenticity of Beccari's observations on the distribution of sexes in the individual spadices and plants of the genus *Dæmonorops,* even of *D. angustifolius,* in which species Ridley appears to be quite positive of the bisexuality of the spadices. No doubt Ridley's collections in the Singapore Herbarium often show male and female spadices on the same sheet, or on different sheets, but bearing the same number, as if the specimens were collected from the same plant or clump. But still there are strong objections to basing conclusions upon such an evidence. Ridley numbered his specimens, not in the field, but in the herbarium and after study; and there are many instances to show that he did not hesitate to give one and the same number to specimens that, although obviously not derived from the same clump, appeared to him to represent the same species (cf. my remarks on *D. angustifolius* and *D. grandis*). As to his observations in the field, besides mistaking a neutral flower for a male in *D. angustifolius,* it has to be noted that he has sometimes taken a young female spadix for a male (*vide*

my remarks on *D. setigerus* in Gard. Bull. S.S. VIII, 1935 p. 363); and from such erroneous observations, he has concluded that the genus *Dæmonorops* is normally monoecious, male and female flowers being found in different spadices (*Materials, II 1907, pp. 171 and 172*), and in his Flora (*V, 1925, p. 34*) Ridley has persisted in his opinion despite Beccari's adverse criticism.

It is true that, as pointed out by Beccari (op. cit. XI, 1908, p. 18; XII, 1911, p. 2), a rattan female spadix might occasionally bear, at its apex, a few spikelets composed entirely of male flowers (*e.g., Calamus perakensis,* not observed in *Dæmonorops*). or that the hermaphrodite flowers might be found here and there on a male spadix. But this is not the usual phenomenon either in *Dæmonorops* or in *Calamus;* therefore one cannot rightly regard it as establishing that either of these genera is normally monoecious with unisexual spadices.

7.—Sex of the Clump.

Though observations so far made show clearly that *Dæmonorops* plants bear male and female spadices in different individuals, it is not yet very clear whether the individual stems in a clump are all alike in sex. I have seen several live clumps of *Dæmonorops*, and, as far as it could be ascertained, the clumps were always of one sex; that is, if one individual was found to be male, then all the other individuals in the same clump were noticed to bear male spadices; the same was true for the female sex. But in one single clump of *D. fissus,* growing in the Singapore Botanic Gardens, I found male and female plants (male in the majority) in the same clump. Now the question arises whether this clump with male and female individuals, is a result of one or two seedlings being planted in the place. Our records do not throw any light on the matter; but further observations in the forests might enable one to say definitely whether a male clump will occasionally produce female individuals, or vice-versa.

8.—Is Dæmonorops Parthenogenetic?

Though *Dæmonorops* species are normally dioecious, it does not follow that they are dependent invariably on the male plants for the production of the fruit. In some species of *Dæmonorops* of the section CYMBOSPATHÆ the female flowers attain their full maturity and develop into fruits when the spadix is still enclosed in the spathes. Hardly any pollinating agent can have access to the flowers shut within the spathes, and excepting the ants, which seem to have a special predilection to all kinds of rattans, and which possibly are the only visitors that might gain admission to the flowers through the enclosing spathes, one rarely, if ever, sees any insect or bird visiting the female spadices. For carrying pollen for long distances, however, the ant is an

almost negligible agent. Unless we assume, then, that the fruits develop parthogenetically—a fact that would mean the male plants are useless,—it is difficult to explain the development of good fruits in such species as *D. angustifolius, D. grandis,* and *D. fissus* (species observed by me) when there exists no male plant of any *Dæmonorops* species within a radius of about 300 feet, or, may be, considerably more.

In this connection it is to be observed that the spadices in some cases show two kinds of female flowers, one with ovaries fully expanded before the anthesis of the inflorescence, and the other not so expanded. Normally only the expanded flowers develop into fruit. But may it not be that the development of the other flowers are dependent upon their receiving pollen from male plants? This explanation, which might account for the existence of the male plants in *Dæmonorops* as well as for the two kinds of female flowers on a spadix, is suggested here with a view to focussing attention on this problem and to encourage field observations.

On the other hand it is possible that, during the early stages of the development of the spadix, the smaller flowers that later fail to develop, are merely those that lag behind in the competition between the flowers for food, and for space in the spadix.

It may be observed that in the Singapore Botanical Gardens there is a female clump of *D. Kurzianus* Becc. *ex descriptione* which always produces female individuals, and, though fruits develop to a large adult size, seeds within the scale-covering remain always abortive. The plant is a native of the Andamans, and, as this group of islands have a somewhat different climate than that of the Singapore Garden, it is possible that this lack of development of good-seeded fruits is not attributable to the absence of male plants of the species in the Singapore Gardens : A species that in its native habitat is parthenogenetic, may refuse to produce, in a different climate, any seeds even when pollinated.

All this will show how sparse is our knowledge about certain biological problems concerning the sex in *Dæmonorops* and will indicate the necessity of utilizing every available opportunity of making field observations on the subject.

9.—Systematic Notes.

I. **Dæmonorops angustifolius** (Griff.) Mart., Hist. Nat. Palm. III (1850) 329; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 464, in Rec. Bot. Surv. Ind. II (1902) 219, et in Calc. Ann. XII (1911) 69 t. 18; Ridl. in Journ. Roy. Asiat. Soc. Straits Br. 33 (1900) 175 et 57 (1911) 110, Mat. Fl. Malay Pen. II (1907) 174, et Fl. Mal. Pen. V (1925) 36, omnino pro parte.

Calamus angustifolius Griff. in Calc. Journ. Nat. Hist. (1844) 89, et Palms Brit. Ind. (1850) 95 tt. 213 A and B (*Type locality* = Malacca).

D. carcharodon Ridl., Mat. Fl. Mal. Pen. II (1907) 178 et. Fl. Mal. Pen. V (1925) 40.

D. hygrophilus Mart. *sensu* Ridl. in Journ. Roy. Asiat. Soc. Str. Br. 33 (1900) 175, Mat. Fl. Mal. Pen. II (1907) 178, et Fl. Mal. Pen. V (1925) 40, pro parte. **syn. nov.**

Malay Peninsula: **Pahang,** Sungei Bera near Tasek Bera (Henderson, 24,620). **Perak,** Temango (Ridley, 14,719, female). **Malacca,** loc. incert. (Griffith, [vern. name *Rotan Ghitah*] in Calc. Herb. Holotype). **Selangor,** Batang, Berjuntai (Ridley, 7880); Batu Tiga (Ridley 11,983*). **Johore,** Mawai Jemaluang Road (Corner, 29,749, vern. name *Rotan Manau*); Sungei Semangat in Muar (Fox, 11,299); Danan, along Sungei Sedili (Corner, on 27–III–32, vern. name *Rotan Tawar*). **Singapore,** Bukit Panjang (Ridley in 1907; and n. 13,302); Choa Chu Kang (Ridley, in 1896*); Bukit Timah (Ridley in 1900); Bukit Mandai (Ridley in 1900); Selitar (Ridley, 6279*); Chan Chu Kang (Ridley, 4622, vern. name: *Rotan Sepat*).

Griffith's type specimens in the Calcutta herbarium consist of the terminal portion of a leaf and the portion of a male spadix, figured in Griffith's plate 213-A, as well as of the petiole with its sheath figured in the plate 213-B. The unopened inflorescence and the detached spathes figured in the second plate are not represented in the specimen; judging by the description Martius gives of the species they are to be found perhaps in the Munich herbarium. Certainly they are not in Kew. A comparison of the authentic material in the Calcutta herbarium, and of Griffith's plates, with the Peninsular material from the Singapore herbarium leads me to concur fully with Beccari's interpretation of *D. angustifolius*. The prickles on the leaf-sheath are rather short in the authentic specimen, but this is no doubt due to the young age of the specimen.

Ridley was much confused over this species. Apparently he took as equivalent all the specimens bearing his field number 5123, though he had given this number to specimens collected from more than one clump, growing in the Singapore Botanical Gardens, and belonging to more than one species (*e.g. D. angustifolius,* and *D. grandis*). Further, from some insufficient data he came to the erroneous conclusion that spadices in *D. angustifolius* are always bisexual. It is not surprising therefore, that, with such a mixed herbarium material to go by and with a mistaken conception concerning the sex of the spadices of the species, Ridley not only erected the new species *D. carcharodon* to include the specimens that did not fit in with

* Syntypes of *D. carcharodon* Ridl.

his acceptation of *D. angustifolius* (Materials II, 1907, p. 178), but later (Flora V, 1925, p. 40) dismissed as erroneous Beccari's placing of the new species among the synonyms of *D. angustifolius* (Calc. Ann. XII, 1911, p. 69).

Ridley's specimen no. 5123 that Beccari quoted as having been collected from a wild plant at "Lawas" in Singapore, is derived from a plant cultivated in the Botanic Gardens, Singapore, the word "Lawas" being a result of misreading of the word Lawns, the garden being divided into a number of sections called lawns. Ridley's no. 11,983 from Selangor—a syntype of *D. carcharodon*—is mounted on two sheets and consists of a mixture of three species, as follows: leaflets of *Calamus scipionum*; fruits and fruiting spadix of *D. grandis;* and a leaf-sheath, a portion of leaf-lamina and an unopened, male spadix of *D. angustifolius.*

The Peninsular material varies a good deal regarding the armature of the petiole, leaf-sheath, the leaf-rachis, and second spathe, so that it might be possible to reduce *D. trichrous* Miq. as a synonym of this.

II. Dæmonorops angustispathus Furtado **spec. nov.**

D. grandis Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 177 et Fl. Mal. Pen. V (1925) 38 quoad specimen Ridleyanum infra citatum. *Syn. nov.*

D. Lewisianus Mart., Hist. Nat. Palm. III (1850) 327; Becc. in Calc. Ann. XII (1911) 87 t. 30 : Omnino quoad specimen Gaudichaudianum in herb. Parisiensi. **Syn. nov.**

A *D. grandi,* cui affinis est, inflorescentiis spathisque angustioribus, ante anthesin lineario-lanceolatis; spathæ extimæ rostro multo longiore quam corpore; frondium segmentis angustioribus hæc species facile distingui potest.

Caudex, vagina. petiolusque ignoti. *Lamina* frondium, secundum partem visam, magna, rhacheos dorso inermis, vel aculeis solitariis tenuibus brevibus distantibus armata. *Cirrhum* non visum. *Segmenta* plura, subequidistantia, 4–5 cm inter se remota, lineario-lanceolata vel ensiformia, maxima latitudine ad medium vel infra sita, 45 cm longa, 15–18 mm lata, apicem versus valde angustata, acuminatissima; supra secus tres costas setulosa, vel interdum in costa media inermia vel apicem ejusdem versus tantum armata; subtus ad costam mediam tantum setulis approximatis prædita. *Inflorescentia fœminea* sessilis, cum rostro lineario-lanceolato 25 cm. superante 45 cm. longa. *Spathæ* persistentes: *extimæ* corpus 18–20 cm longum, bicarinatum, (tractu intercarinali ad 1 cm. usque lato), deciduo fusco-furfuraceum, aculeis paucis, distantibus, solitariis, interdum confluentibus, laminaribus vel subcriniformibus, nigritellis, ad 2.5 cm. longis armatum; rostrum clausum permanens,

eodemmodo armatum, 25 cm. superans, 5 mm. latum: *secunda* (spatha) et tertia paulo latiores aculeis minoribus, solitariis, secus carinas obsoletas apicem versus tantum parcissime armatæ: internæ inermes. *Rami* spadicum primarii 4, porrecti, ad 6 cm. longi, alternati, 5–6 cm. inter se dissiti; *secundarii* ad 2.5 cm. usque longi, axi rigido, crasso, flexuoso, floribus utrinsecus 2–4. *Involucrophorum* crassum, paulo exsertum, apice crateroideum. *Involucrum* cupuliforme vel pateriforme, 1–2 mm. longum; floris aureola neutrius conspicua. *Perianthium* fructiferum explanatum, tepalis interioribus subduplo longioribus quam exterioribus. *Fructus* immaturi tantum visi, ovato-elliptici, cum perianthio rostroque 18 mm. longi, 10–12 mm. in diam. *Squamæ* brunneo-gramineæ, in 15 orthostiches imbricatæ, in linea infra marginali atriores.

Malay Peninsula: **Province Wellesley,** Bukit Juru (Ridley, 7002. Holotype in Singapore). **Penang,** loc. incert. (Gaudichaud, in the Paris Herbarium).

I have not seen the actual specimen collected by Gaudichaud but only its photographic plate given by Beccari (*plate 30* in the *Calc. Ann. XII, 1911*). Apparently Beccari mistook the outermost spathe for one of the internal and so he remarked that the specimen of Gaudichaud in the Paris Herbarium as well as its duplicates in the Geneva and the Florence herbaria bore male spadices without their outermost spathes; and yet the outermost spathe is represented in Beccari's plate of Gaudichaud's specimen. The body of this spathe measures only 18 cm. in length, while the beak, which is placed vertically on the extreme left of the plate, is more than 35 cm. long.

Were it not for the narrow leaflets, the long beaked inflorescence and the narrow spathes, *D. angustispathus* would have been extremely difficult to distinguish from *D. grandis* with which the species was confused by Ridley. Leaf-sheaths are wanted to bring out further differences.

III. Dæmonorops calicarpus (Griff.) Mart., Hist. Nat. Palm. III (1850) 326 t. 175 f. vi.; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 466; Ridl., Mat. Fl. Mal. Pen. II (1907) 174 pro parte; Becc. in Calc. Ann. XII (1911) 94 t. 34; Ridl., Fl. Malay Pen. V (1925) 37 pro parte (ex altera parte = *D. intermedius, D. Lewisianus, D. sepal,* and *D. tabacinus*).

Calamus calicarpus Griff. in Calc. Journ. Nat. Hist. V (1844) 92, et Palms Brit. Ind. (1850) 99 tt. 215-A, B, C and D et t. 216-A f. V and VI. (*Type locality* = Malacca).

Malay Peninsula: **Kemaman,** Bukit Kajang, near Ulu Bendong, alt. 500 ft. (Corner, 30,077; 30,389). **Perak,** Bujong Malacca (Curtis, 3160); Tapak (Ridley, 14,115). **Dindings,**

Lumut (Ridley, 7899; Curtis 3444, female). **Malacca,** Chinana Puteh (Alvins, 979, vern. name *Rotan Chucho Miniak*); Bukit Sadanan (Pun Bebas=Derry's collector, 112, vern. name *Rotan Sabut*). **Selangor,** Kuala Lumpur (Ridley in 1899); Dusun Tua (Ridley, 7878).

IV. Dæmonorops congestus Ridl., Mat. Fl. Malay Pen. II (1907) 178 et Fl. Mal. Pen. V (1925) 40.

The type of this species is a specimen collected by Ridley in Singapore in a place that was called the Stagmount by the English, and Bukit Panjang by the Malays. The specimen does not bear any date or number. After examining a duplicate of the type Beccari reduced the species to *D. leptopus,* making at the same time the following remarks on its status: "I have reduced *D. congestus* of Ridley to *D. leptopus* after a very careful analysis of a specimen kindly sent to me by its author. It is true that this specimen (which is very incomplete, and has very immature fruits) has spikelets with the flowers more approximate than usual; but this specimen does not appear to me quite normal" (cf. *Calc. Ann. XII,* 1911, pp. 128, 131).

As Ridley in his later work did not agree with this reduction made by Beccari, and moreover he insisted in placing the species in section CYMBOSPATHÆ (*D. leptopus* belongs to the section PIPTOSPATHÆ) I re-examined the type of *D. congestus,* which is in the Singapore herbarium, and as a result I fully concur with Beccari's remarks on the status of the species. Apparently Ridley relied for his information of the specific description more on his fieldnotes than on the actual type specimen, and so in his *Flora V, 1925 p. 40,* he repeated the erroneous statement originally made in the *Materials II, 1908, p. 179* even as to the length of the spadix. A fragment of the peduncle of the spadix in the type specimen measures more than 4 inches. This fact and the length of the spikelets or of the portions of partial inflorescences (primary branches) show that the spadix is very long, belonging to the section PIPTOSPATHÆ. Ridley's original statement that the spadix is only 2 inches long was perhaps due to a *lapsus calami* in his fieldnotes for 2 feet long—a mistake that would have been easily detected had Ridley, instead of relying on his notes, re-examined the type specimen before preparing the specific description for his *Flora.*

Two more specimens collected by Ridley on the Stagmount are likewise labelled *D. congestus* by Ridley himself. But, though they both belong to CYMBOSPATHÆ, it is obvious that they did not form the basis of *D. congestus,* for they not only do not agree with Ridley's description of the species, but they were collected only in 1908, a year after the original

publication of the species. These latter specimens, (numbered 13,302), are *D. angustifolius* as interpreted herein.

V. Dæmonorops Curtisii Furtado **spec. nov.**

A *D. Lewisianus,* cui valde affinis, vagina frondium inerme, haud geniculata; spathis inermibus hæc species bene distincta.

Caudex gracilis, cum vagina 8 mm. in diam., erectus vel semiscandens. Frondium *vagina* inermis, haud gibbosa, pro maxima parte atro-ferrugineo leprosa, apice oblique truncata. *Ochrea* inermis, ad 5 mm. longa. *Petiolus* circ. 15 cm. longus, dorso convexus, supra concavusculo-applanatus, inermis vel secus margines dorsumque spinis perpaucis, solitariis, brevissimis vel obscuris remote armatus. Lamina 25–30 cm. longa, secus rhacheos dorsum unguibus indivisis, reduncis, brevibus prædita, in cirrhum ad 10 cm. longum unguiculatum transiens. *Segmenta* circ. 12 cm. longa, 1 cm. lata, ensiformia, apicem quam basin versus magis attenuata; supra secus costam medianam et interdum duas costas subprimarias, subtus secus costam mediam tantum, setulosa; ad margines eodemmodo ciliolata. *Spadix* ante anthesin elongato-fusiformis, cum rostro circ. 12–14 cm. longus; spatha extima inermis, dorso superficialiter bicarinata, in rostrum circiter corpore ejusdem æquilongum contracta. *Perianthium* fructiferum explanatum. *Fructus* immaturi tantum visi, ovati, apicem versus angustati, circ. 12–13 mm. longi, 8–10 mm. in diam. *Squamæ* in orthostichos 15 dispositæ, in medio sulcatæ, basi stramineæ, apicem versus rebescentes, linea marginali fuscente.

Malay Peninsula: **Province Wellesley,** Tasek Glugor (Curtis in April 1902. Type in Singapore).

Obviously an ally of *D. Lewisianus* from which it is easily distinguished by unarmed leaf-sheath, non-gibbous petiole, and unarmed spathes. The two last mentioned characters are sometimes found in the spathes of *D. Lewisianus* produced in the "senile" stages, but even then one can always detect some spines or bristles on the leaf-sheaths and very often on the outermost spathes. Curtis's specimen is evidently taken from the terminal portions of an old stem; because owing to the disarrangement in the rate of growth of the internodes and leaf-sheaths, the spadices appear as if they have originated in the axil of the leaf immediately below it. The basal portion of the spadices being thus caught up in pseudo-axils of the leaves, the outermost spathes do not fall off even after they are detached from the inflorescence axis, thereby making the spathes appear as persistent. Such a condition is sometimes obtained in many rattans in their "senile" stages, that is, stages immediately preceding their death.

VI. Dæmonorops grandis (Griff.) Mart., Hist. Nat. Palm. III (1850) 327 t. 175 f. 9 et t. Z-xii f. 11; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 463, in Rec. Bot. Surv. Ind. II (1902)

219 et in Calc. Ann. XII (1911) 58 t. 11; Ridl., Mat. Fl. Mal. Pen. II (1907) 177 et Fl. Mal. Pen. V (1925) 38. *pro parte.*

Calamus grandis Griff. in Calc. Journ. Nat. Hist. V (1844) 84 et Palms Brit. Ind. (1850) 91 tt. 210 A, B, and C, et t. 216 f. 3.

D. *angustifolius* Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174 et Fl. Mal. Pen. V (1925) 36 *pro parte.* **Syn. nov.**

D. hygrophilus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907)178 et Fl. Mal. Pen V (1925) 40 p.p. **Syn. nov.**

D. intermedius Mart. *sensu* Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 464 et in Calc. Ann. XII (1911) 73 t. 20 pro. maj. parte and excl. spec. Griffithianum. **Syn. nov.**

D. intermedius var. *nudinervis* Becc. in Rec. Bot. Surv. Ind. II (1902) 220 nomen nud., et in Calc. Ann. XII (1911) 75 tt. 21 et 22. **Syn. nov.**

D. Kirtong Griff., Palms Brit. Ind. (1850) 102 t. 216 B. **Syn. nov.**

D. malaccensis Mart. tom. cit (1850) 327; Bec. in Rec. Bot. Surv. Ind. II (1902) 222 et in Calc. Ann. XII (1911) 61 quoad t. 216 B. **syn. nov.**

D. malaccensis Mart. *tom. cit* (1850) 327, Bec. in Rec. Bot. Surv. Ind. II (1902) 222 et in Calc. Ann. XII (1911) 61 quoad t. 216 B. **Syn. nov.**

Calamus acanthopis Griff., Palms Brit. Ind. (1850) t. 216 B. **Syn. nov.**

Malay Peninsula: **Kedah,** Kedah Peak=Gunong Jerai (Ridley in 1893), **Province Wellesley,** Tasek Glugor (Burkill, 6536). **Pahang,** Tasek Bera (Henderson, 19484, vern. name *Rotan Relang* and Sakai name=*Chongkak*). **Negri Sembilan,** Bukit Sutu in Sungei Ujong district (Alvins, 1878, vern. name *Rotang Sunang*); Senaling Inas (Holttum 9778, vern. name *Rotang Kerotong*); Tampin (Burkill; 1372; 2551). **Selangor,** Pataling (Ridley on 27-vi-1889) the spathes only. **Singapore,** Bukit Arang (Goodenough, 1660); Bukit Mandai (Ridley in 1890); Changi (Mat in March 1894); Bidadari (Ridley 8957); Ang Mo Kio (Ridley 6672); Bukit Timah (Goodenough in 1892, vern. name *Rotang Chinchin;* Ridley in Feb. 1900; in 1890; 1892; and in 1898); North Selitar (Ridley, 3506 and 3499); Selitar (Goodenough in 1890); Ridley, 3498); Gardens' Jungle (Ridley 5122; 5123* and 5124). **Malacca:** Chinana Puteh (Alvins, 890, vern. name *Rotang Sunang*); Bukit Sadanen (Pun Bebas= Derry's collector, 110, vern. n. *Rotan Chichik Landak*; ibid., 108, vern. n. *Rotang Cheranang*).

* This number is also given to specimens of *D. angustifolius.*

Calamus acanthopis and *Dæmonorops malaccensis* are exact synonyms of *D. kertong*, all the three names being based on the same material referred to as *Rotang Kertong* by Griffith in a foot-note under *C. petiolaris* var. *B.* in Calc. Journ. Nat. Hist. V (1844) 94. As Griffith had considered it to represent a new species but had supplied no botanical name, Martius supplied the name in 1850 by calling it *D. malaccensis*, Griffith's names *Calamus acanthopis* and *Dæmonorops kertong* being published in a posthumous work in the same year. The type material consisted of two spadices [though a portion of radical leaf is also represented in the figure given in Griffith's posthumous work, Palms Brit. Ind. (1850)]. As neither of these spadices nor the leaf portion is in the Calcutta herbarium, and as Beccari, who had examined Griffith's specimens preserved in the Kew herbarium, could not see the type specimens, and as Martius noted that he had seen the spadices, it is to be presumed that the spadices are in Martius's herbarium in Munich. From the drawings given by Griffith, it is evident that the two spadices represent *D. grandis*, each having lost its outermost spathe. The vernacular name *Rotang Kirtong* with its variants is still being used by the Peninsula Malays to denote *D. grandis*, though the name is sometimes used for *Calamus scipionum* or for an allied species or for a species of *Plectocomiopsis*, which, owing perhaps to its tufted growth and broad and distant leaflets, are classed by the Malays with the former. The specimens that Beccari identified as *D. malaccensis* do not belong here (cf. my remarks on *D. melanochætes*).

Ridley gave the number 5123 to specimens taken from more than one clump growing in the Singapore Botanic Gardens. Since a specimen bearing this number was determined by Beccari as *D. angustifolius* (later figured in the Plate 18 of the *Calcutta Annals* XII, 1911), Ridley concluded that all his specimens bearing the same number were *D. angustifolius*, though a greater part of them are *D. grandis*. I think this faulty numbering has been one of the main causes why Ridley was much confused over *D. grandis* and *D. angustifolius* (*see* my remarks on the latter species).

Ridley has quoted the Pataling specimen (Selangor) and Pun Bebas (=Derry's Collector) n. 110 (from Malacca) under *D. hygrophilus*. But with the exception of the leaf on the former, which by reason of its being from a radical leaf, is not identifiable, both the specimens consist of unopened spadices belonging to *D. grandis*. On Pun Bebas specimen n. 108, *Rotan Cheranang*, is recorded as its vernacular name, but obviously through a mistake for the name *Cheranang* or *Jernang* (or *Jeranang*), is invariably applied by Malays to a *Dæmonorops* species yielding dragon-blood.

In the *Materials II, 1907, p. 178,* Ridley has left the following remarks on *D. grandis*: "I am quite unable to distinguish *D. intermedius* Mart. (*Calamus intermedius* Griff.), though Beccari keeps it separate and describes [?] a variety *D. intermedius* var *nudinervis*. Griffith, the original describer of it, was dubious [?] as to its being distinct, and the two very slightly different forms pass readily into each other. Both grow side by side in the gardens and garden jungle, and as usual in this group there is a great variation in the size of spathe, dimensions of spines, and bristleness of the leaves, according to the age of the plant and its habitat".

These remarks of Ridley are certainly applicable to Beccari's interpretation of *Calamus intermedius* Griff., but not to this species in its original sense. Griffith's species is allied to *D. Lewisianus,* having much narrower and closer leaflets than in *D. grandis.* (cf. my remarks on *D. intermedius*). Another important character that distinguishes *D. intermedius* from *D. grandis,* and which was also noted by Griffith, lies "in the armature of the spathes, the thorns of which are very slender, more deflexed, and much more numerous". Beccari's *D. intermedius* var. *nudinervis* was included in Griffith's *D. grandis* as the leaflets of the latter were described as being "without setæ on either surface or along the margins, or with the midvein setigerous on both surfaces, as well as on the margins."

Griffith's plate 211-A of *D. intermedius* is also very clear and cannot be easily mistaken for *D. grandis.* It approaches some forms of *D. angustifolius* with rather distant leaflets and narrower thorns on the spathes. (cf. my remarks on *D. intermedius*).

Ridley gives *Rotan Sumang* as a vernacular for the species, but Alyins spells the name as *Rotang Sunang.*

VII. Dæmonorops hygrophilus Griff. ex Mart., Hist. Nat. Palm III (1850) 204 et 328, t. 177 f. II; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 464; Ridl., Mat. Fl. Mad. Pen. II (1907) 178 quoad specimen Griffithianum tantum; Becc. in Calc. Ann. XII (1911) 62 t. 13; Ridl., Fl. Mal. Pen. V (1925) 40 pro parte.

Calamus hygrophilus Griff., Palms Brit. Ind. (1850) 96 t. 213-C. (Basinym) Malacca.

D. angustifolius Mart. *sensu* Ridl. in Journ. Roy. Asiat. Soc. Str. Br. 57 (1910) 110 pro parte. **Syn. nov.**

?D. fissus var. *cinnamomeus* Becc. in Calc. Ann. XII (1911) 67 t. 16.

Malay Peninsula: **Perak,** R. Temango (Ridley, 14,719, male only; female=*D. angustifolius*). **Kemaman,** Ulu Kajang,

alt. 500 ft. (Corner, 30,447, vern. name *Rotan Tawar*). **Selangor,** Telok Forest Reserve (Burkill, 6520). **Malacca,** loc. incert. (Fernandez, vern. name *Rotan Ayer.* Type; not seen). **Johore,** Kota Tinggi, by Sungei Johol (Corner, 29,750). **Singapore,** Bukit Panjang, at Stagmount (Ridley, in 1907).

SUMATRA: **Palembang,** Lematang Ulu, alt. circ. 500 (Grashoff, 196=Herb. Bog. n. 404, vern. name *Uwi Getah*); between Banjuasin and Kubus, alt. 60 feet (Grashoff, 639, vern. name *Rotan Kelemunting*) (both specimens from herb. bogor.).

BORNEO; **Pontianak** (Heyne, 2548=Herb. Borgor. n. 222, in herb. Bogor.). **Sarawak,** Bau (Ridley 11,826).

The species, which had up till now been regarded as endemic in the Peninsula, was not clearly defined, and its status had therefore been rather doubtful. I have not seen Scortechini's specimen cited by Beccari, but from its plate, Beccari's identification appears to be correct. The type is not in the Calcutta herbarium, but might be found in the Munich herbarium, where Griffith had sent the material for Martius's study. But the two plates by Martius, and by Griffith, bring out clearly the characters in the petiole that distinguish the species from *D. angustifolius. viz.*, Geniculum unarmed, or armed only along the ridge with a few, small, rigid prickles; and the petiole armed along the margins, and occasionally with a few solitary prickles along the dorsum. In addition the spathes and sheath are usually blackish with crustaceous indumentum. In *D. angustifolius,* the geniculum and both the surfaces (occasionally one) of the petioles are armed with scattered rigid prickles. The spines on the spathes and also on the leafsheaths of *D. hygrophilus* are short and narrow, and scattered; not broad and long, often laciniate and very close, as in *D. angustifolius.*

The Singapore and the Johore material is fruiting and shows that the scales are arranged in 16-18 vertical series. The mature fruits (in the Singapore specimen) are ovoid-globose, depressed at base, shortly beaked at apex, 14–15 mm. in length (excluding the beak), 15–17 mm. in diam. They resemble very much the fruits of *D. angustifolius* but are lighter coloured.

The Sumatran material cited above, which was obtained from the Buitenzorg herbarium on loan, has been named by Beccari as *D. trichrous* Miq. The Bornean material, which appear to be *D. fissus* var. *cinnamomeus* may belong here.

VIII. Dæmonorops intermedius (Griff.) Mart., Hist. Nat. Palm. III (1850) 327 t. 175 f. 8; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 464 et in Calc. Ann. XII (1911) 173 quoad specimen Griffithianum (altera=*D. grandis*).

Calamus intermedius Griff. in Calc. Journ. Nat. Hist. V (1844) 86 et Palms Brit. Ind. (1850) 93 t. 211 A and B (*Type locality* = Malacca).

D. calicarpus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174 et Fl. Mal. Pen. V (1925) 37 pro parte. **Syn. nov.**

D. grandis Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 177 et Fl. Mal. Pen. V (1925) 38 quoad syn. *D. intermedius*. **Syn. nov.**

Malay Peninsula: **Malacca,** loc. incert. (Fernandez, vern. name *Rotan Crysa*. Type in Calc. Herb.). **Johore,** Bukit Soga (Ridley, 11,205, female specimen only; male = *D. melanochætes*).

The type specimen in the Calcutta herbarium is in a fragmentary condition and without external spathes, which, however, seem to have been present when Beccari examined it. This specimen has given rise to a considerable confusion, because the absence of the spathes, in addition to the incompleteness of the extant parts, makes extremely difficult the identification of the species with any certainty. Anyhow, that it cannot be the species accepted as such by Beccari is evident, for that has very broad leaflets, whereas Griffith's description and the specimen itself indicate that *D. intermedius* is a narrow-leaved species like *D. angustifolius* and *D. Lewisianus*.

Beccari's interpretation of *D. intermedius* was based on Scortechini's collection that seems to have been so mixed with parts of another species that Beccari must have been misled to regard all the specimens in the collection as having been derived from the same plant or clump; and presumably this is the reason why he explained away the differences he detected principally in the armature of the outermost spathes by considering the species as very variable or polymorphous. From Beccari's plate 20, I would regard the detached spathe (on the right hand side of the plate) to be *D. angustifolius;* but obviously the major part of *D. intermedius* sec. Beccari is *D. grandis*.

In making the identification of *D. intermedius* in the Griffithian sense, I have used the type specimen together with the description and the plates publised by Griffith. The important clue to the identification of Griffith's species with Ridley's specimen quoted above is the armature of the second spathe, which is noted by Griffith as thickly armed. There are only two species known to occur in the Malay Peninsula (in Malacca or in its neighbourhood), that would answer this description: the one is represented by the specimen I refer here to *D. intermedius;* and the other is *D. melanochætes*. The latter, which also produces spathes very like the example depicted by Griffith, bears bristles down to the very base of the inflorescence and even on the peduncular part that is adnate to the sheath, the bristles in the latter part being as a rule very closely set. There are

also noticeable differences in the armature on the basal portion of the petiole and on the apex of the sheath in these two species, *D. melanochætes* being more thickly and conspicuously armed in these parts than *D. intermedius*. In Ridley's specimen quoted above the spadix is practically unarmed at the base; and Martius, who had seen a specimen from Griffith, described the peduncle as "subinermis". But *D. intermedius* as interpreted here appears to be a very close relative of *D. melanochætes*, and observations in the field and better herbarium specimens are necessary to determine whether the former species represents merely an ecologic or varietal form of the latter. To achieve this purpose, it would be useful if the collectors could procure specimens showing the full range of variability of sheaths and spathes in the two species. See also my remarks on *D. melanochætes*, *D. grandis*, and *D. monticolus*.

IX. Dæmonorops javanicus Furtado **spec. nov.**
D. stenophyllo et *D. singalano* propinqua est, sed ab illo spatharum spinis subacicularibus valde gracilioribus ac pluribus; et ab hoc spadicibus sessilibus vel penduculis valde brevioribus, erectis, haud reflexis, hæc species facile distingui potest. A grege, cui *D. angustifolius* pertinet, spatharum spinis valde gracilioribus; fructibus immaturis sphæroidioribus, haud ellipticoovatis; squamis (margine albescente excepta) fere concoloribus, cum canaliculo profundiore differt.

Caudex scandens, cum vagina 2.5-3 cm. in diam.; frondibus magnis cirrhiferis. *Vagina* frondium infra petiolum gibbosa, apice suboblique truncata, aculeis laminaribus, elasticis schistosis, ad 3.5 cm. longis, basi 3.4 mm. latis, per series obliquas interruptasque confluentibus, apice ejusdem spinis longioribus, porrectis. *Petiolus* 15 cm vel longior, subtus secus dorsum aculeis dimensione variablilibus dispersis, in geniculo ad dorsum tantum armatus, supra canaliculatus lævigatus, inermis. *Lamina* magna, in cirrhum terminans, secus rhacheos dorsum unguibus 3-7-fidis armata. *Segmenta* plura, ensiformia, 2.5–3.5 cm. inter se remota; 30-38 cm. longa, 13-18 mm. lata, maxima latitudine infra medium sita, apicem versus sensim acuminata, basi abrupte contracta, plicatula, nervis transversalibus conspicuis; supra ad costas duas laterales et margines, ad costam mediam in tertia parte terminale tantum, setulosa; subtus inermia. *Inflorescentiæ* foemineæ sessiles vel pedunculo 1– 1.5 cm. longo praedita, cum. rostro 5-7 cm. longo, inermi vel fere, 22-25 cm. longæ. *Spathæ primariæ*: *infima* cymbiformis, bicarinata, aculeis 1-2.5 cm. longis, subacicularibus, basi 1–2 cm. latis, solitariis vel confluentibus armata; *interiores* inermes, conspicue nervosæ. *Spathæ secundariæ* bracteiformes amplectentes. *Spathellæ* consimiles, in apicem triangularem involucrophorum æquantem vel superantem productæ. *Involucrophorum* obconicum obsoleto angulatum, apice in cupulam asymmetricam oblique truncatam

expansum. *Involucrum* cupulare, truncatum, in involucrophoro fere totum immersum. *Perianthium* fructiferum explanatum. *Fructus* immaturi tantum visi, globosi, 10–12 mm. in diam (sine apiculo 2-3 min. longo). *Squamæ* per series 15-18 imbricatæ, concolores vel fere, fusco-gramineæ, secus marginem albescentes, apice atrescentes, dorso conspicue-canaliculatæ.

JAVA: **Preanger,** Gedeh (Heyne, 2,670=Herb. Bogor. num. 468. Holotype in Herb. Bogoriensi).

Besides the widely distributed, polymorphous *D. melanochætes,* no *Dæmonorops* of the section Cymbosthæ had been recorded from Java. *D. javanicus* records therefore another species of the section for Java. The nearest ally of this are the mountain species of Sumatra and the Malay Peninsula, belonging to the group of *D. singalanus.* The leaflets are quite unarmed in the lower surface, a condition that might not be constant in the species. In the gibbose part of the petiole there is a band on either side of the ridge where the spines are absent, though a little further on in the sheath (in the portion that may be called the wings of the puckered part of the petiole) the spines are both conspicuous and large.

X. Dæmonorops Lewisianus (Griff.) Mart., Hist. Nat. Palm. III (1850) 327 t. 175-iv f. 1-7 excl. specimen Gaudichaudianum; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 465; Ridl., Mat. Fl. Mal. Pen. II (1907) 176 pro parte (ex altera parte=*D. melanochætes* and *D. grandis*); Becc. in Calc. Ann. XII (1911) 87 t. 30 pro parte (ex altera parte=*D. angustipathus*); Ridle., Fl. Mal. Pen. V (1925) 38 partim.

Calamus Lewisianus Griff. in Calc. Journ. Nat. Hist. V (1844) 87, et Palms Brit. Ind. (1850) 94 t. 212. Type locality=Penang.

D. angustifolius Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174 et Fl. Mal. Pen. V (1925) 36 pro parte. **Syn. nov.**

D. calicarpus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174 et Fl. Mal. Pen. V (1925) 37 pro parte. **Syn. nov.**

D. microthamnus Becc. in Rec. Bot. Surv. Ind. II (1902) 221; Ridl., Mat. Fl. Mal. Pen. II (1907) 175; Becc. in Calc. Ann. XII (911) 92 t. 32; Ridl., Fl. Mal. Pen. V (1925) 37. **Syn. nov.**

D. monticolus var. B Becc. in Rec. Bot. Surv. Ind. II (1902) 221 *nom. nud.*

D. monticolus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 175 et Fl. Mal. Pen. V (1925) 37 pro parte (quoad specimina penangensia) **Syn. nov.**

D. monticolus var. *pinangianus* Becc. in Calc. Ann. XII (1911) 85 t. 29 excl. tab. Griffithianam. **Syn. nov.**

D. petiolaris Mart., Hist. Nat. Palm. III (1850) 326 t. Z-xviii f. 3; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 466 et in Calc. Ann. XII (1911) 90 t. 31. **Syn. nov.**

D. petiolaris var. *nudipes* Becc. in Rec. Bot. Surv. Ind. II (1902) 221. **Syn. nov.**

C. monticolus Griff. *sensu* Griffith, Palms, Brit. Ind. (1850) 97 quoad specimen penangense. **Syn. nov.**

C. petiolaris Griff. (incl. vars. A and E) in Calc. Journ. Nat. Hist. V (1844) 93, et Palms Brit. Ind. (1850) 101 t. 216 f. vii. **Syn. nov.**

Malay Peninsula: **Penang,** loc. incert. (Griffith, in Calc. Herb.; Lewis vern. name *Kichun,* in Calc. Herb. Type of *D. Lewisianus;* Curtis, 2232); Waterfall (Burkill, 376); Penara Bukit (Curtis, in July 1893); Penang Hill = Government Hill (Abrams, in 1893; Ridley: 7034; 7895; 7896); Balik Pulau (Ridley; 7900; 7902); Moniots Road (Curtis, 764). **Province Wellesley,** Bukit Juru (Ridley; 7003; 7102). **Dindings,** Pangkor (Ridley, 7897, vern. name *Rotan Kusom*); Lumut (Ridley in Feb. 1892; Curtis, 3444, male specimens only, female specimens = *D. calicarpus,* vern. name Rotan Chuchok). **Perak,** Pulau Rumbia (Seimund, on 15-iii-1925); Gunong Kledang (Curtis, 3351, male and female). **Malacca:** loc. incert. (Griffith, in Calc. Herb).

Sumatra: **Lingga Archipelago:** Pulau Selajar (Bünnemeijer, 7451 in Herb. Buitenzorg); Pasir Panjang (Biinnemeijer, 7016);

At first I thought *D. petiolaris* to be a good species, but after comparing the material with that of *D. Lewisianus,* I find difficulty in keeping it as a species quite distinct from the latter. Ridley's 9897 from Dindings, Ridley's 7003 from the Province Wellesley, Seimund's specimen from the Rumbia island in Perak, Curtis's 3351 (male) from Perak, and Burkill's 376 and Ridley's 7895 from Penang form, so to say, the transitional stages between the extreme forms, which may be called *D. monticolus* var. *pinangianus* and *D. petiolaris.* Griffith's specimen cited here as from Penang bears no locality and is named *Calamus monticolus* var. *E* (= *D. monticolus*); but in all probability it is the Penang specimen Griffith cited under *C. monticolus,* in his second monographic work on Palms (1850). Regarding the armature of its spathes and the apical wings of the leaf-sheaths, the specimen agrees well with Ridley's n. 1895, though the latter is much less leprose. The authentic specimen of *D. petiolaris* (Griffith's specimen from Malacca cited above), which consists of a terminal portion of a radical leaf and an entire upper leaf with its sheath, is too meagre to be of any great help in the identification of the species. The upper leaf measures about 12 inches and the petiole is not terete. Similar leaves are produced by forms of *D. calicarpus* as interpreted here

and so I think Beccari's acceptation of this species is correct, though the species has to be considered as a synonym of *D. Lewisianus*.

The type specimen of *D. Lewisianus* in the Calcutta herbarium (the Penang specimen collected by Lewis) was derived from rather thick rattan and does not correspond to Griffith's plate 212 which is a representation of a terminal portion of the stem approaching a stage referred by Beccari to *D. petiolaris*. In its shape, armature and indumentum this type specimen, which has lost the terminal portion of its spadix, corresponds to Ridley's 7902 referred by Beccari to *D. monticolus* var. *pinangianus*. The species varies a great deal not only in the size and shape of the spadices but also in the length and bristleness of the peduncle; but no important differences can be found to keep these various forms separate as varieties or species. The indumentum on the leaf-sheaths, petioles, and external spathes is also variable, being in some cases very thick and persistent and in others entirely or almost deciduous very early during the course of the development of the organs. These differences are perhaps due to the age and the habitat of both the individual plants as well as of the clump, the suckers produced at a time when the soil around it has been exhausted by preceding suckers and when the competition for space and light has become very acute, becoming very stunted and weak. Perhaps Curtis's 3351 (female) from Gunong Kledang in Perak, which corresponds to Beccari's plate 32 of *D. microthamnus*, represents such a stunted plant, while Lewis's specimen in the Calcutta herbarium and Ridley's 7902 in the Singapore herbarium (forma *D. monticolus* var. *pinangianus*) represent forms produced at a time when the competition between the suckers of the clump for space, food, etc. is not so keen and therefore does not affect the vigour and luxuriance of the individual plants.

The specimen Gaudichaud collected in Penang (preserved in the Paris herbarium), and which Beccari referred to *D. Lewisianus*, is referrable to *D. angustispathus*.

Beccari also referred Ridley's specimens no. 9466 from the Kew and the Calcutta herbaria to *D. Lewisianus*. Beccari's description of these specimen is applicable to Ridley's 9466 in the Singapore herbarium, which I cite under *D. melanochætes*.

XI. Dæmonorops melanochætes Bl. in Roem. et Schult., Syst. Veget. VII (1830) 1333 excl. syn.; Mart., Hist. Nat. Palm. III, ed prima (1836 ?) 198 t. 117 f. II et ed. 2 (1850) 203 et 326 Kunth, Enum, Pl, III (1841) 202; Blume, Rumphia II (1845 ?) tt. 134 et 137, et III (1849) 3; Miq., Fl. Ind. Bat. III (1855) 68; Becc. in Rec. Bot. Surv. Ind. II (1902) 219, et in Calc. Ann. XII (1911) 47.

D. angustifolius Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174, et Fl. Mal. Pen. V (1925) 36, pro parte. **Syn. nov.**

D. Lewisianus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 176 p.p.; Bec. in Calc. Ann. XII (1911) 87 p.p.; Ridl., Fl. Mal. Pen. V (1925) 38 pp. **Syn. nov.**

D. malaccensis Mart. *sensu* Becc. in Calc. Ann. XII (1911) 61 t. 12 (excl. spec. Griffithianum) **Syn. nov.**

D. monticolus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 175 quoad specimina borneensia; Becc. in Calc. Ann. XII (1911) 84 quoad specimen Ridleyanum; Merr., Enum. Bornean Pl. (1921) quoad loc. Borneo tantum; Ridl., Fl. Mal. Pen. V (1925) 37 quoad Borneo. **Syn. nov.**

Calamus melanochætes (Bl.) Griff. in Calc. Journ. Nat. Hist. V (1844) 86, et Palms Brit. Ind. (1850) 92 in nota; Miq., Palm. Arch. Ind. (1868) 28.

D. Schmidtianus Becc. in Schmidt., Fl. Koh Chang IX (1909) 330; et Calc. Ann. XII (1911) 52 t. 7. **Syn. nov.**

? *D. Hallierianus* Becc. in Calc. Ann. XII (1911) 218 t. 99 quoad specimen Hewittianum. ? **Syn. nov.**

Malay Peninsula: **Kemaman,** Bukit Kajang alt. 500 ft. (Corner, 30428). **Pahang:** *Pulau Tioman*: at Sedagong, alt. 1,000 ft. (Nur, 18891); Bukit Surin alt. 1,000–2,000 ft. (Henderson, 21710); Joara Bay (Burkill: 983, vern. name *Rotan Langah*; 1016). **Penang,** Moniot Road (Ridley, 9466). **Province Wellesley,** Bukit Juru (Ridley 7100). **Negri Sembilan,** Gunong Tampin (Holttum 9561). **Johore,** Serom (Ridley, in Nov. 1900); Bukit Soga (Ridley, 11205, male only; the female bearing this no. = *D. monticolus*). Pulau Aor, alt. circ. 600 ft. (Henderson 18358).

Borneo: **Sarawak,** Satubong (Hewitt, in 1906, vern name *Rotan Bahut*); Matang (Ridley, in July 1903); Quop, (Hewitt, 23-iv-1907, n. R.A.).

This species was recorded by Beccari for Java, Borneo and Sumatra, but not for the Malay Peninsula, though Martius had recorded as occuring in the Malay Peninsula in the island of Penang. Merrill (Univ. Calif. Publ. Bot. XV 1929, p. 24) refers to this species Elmer's specimens n. 21102 from Tawao in British North Borneo, but the duplicate material (consisting of a few fruits and leaflets) in the Singapore herbarium does not appear to represent this species.

The Peninsular material of the species has been much confused by Beccari and others. Beccari has regarded Ridley's n. 11205 (male) from Johore as *D. malaccensis* (Griff.) Mart., while he determined a similar specimen collected by Ridley in Penang sub. n. 9466 as *D. Lewisianus* (Griff) Mart. Previous to the

issue of his monograph on Dæmonorops (1911) Beccari communicated his determinations to Ridley, who took it for granted that Beccari's acceptation of the two species of Griffith were correct; and as both the specimens referred by Beccari to the above two species were conspecific, Ridley made *D. malaccensis* a synonym of *D. Lewisianus,* interpreting the species in the sense given to them by Beccari. On a sheet belonging to *D. melanochætes,* Ridley also noted that a plant conspecific with the specimen was cultivated in the Kew Gardens under the name of *D. Lewisisanus* If so, I suspect that this name was given to the plant after its determination by Beccari.

In the first and the second editions of the *Historia,* and also in its *Appendix,* Martius quoted under *D. melanochætes* Bl. a specimen collected by Wallich in Penang. This reference has been noted by Griffith, Kunth, Miquel, etc. In the *Calcutta Annals XII,* 1911, p. 47 Beccari has cited all the references under *D. melanochætes* without making any exclusions, though he does not credit the species to the Malay Peninsula. Neither he, nor Ridley has tried to identify the Wallichian specimen from Penang. Presumably the specimen is not at Kew; and a search may have to be made in Martius' herbarium in Munich* Similarly the Philippine material referred by Martius under this species has to be examined to see whether it had been rightly identified; for neither Beccari nor Merrill (Enum. Philipp. Pl. I, 1922) credits the species to the Philippines.

The Peninsula material of *D. melanochætes* varies a great deal regarding the spininess of the spathes, and the width and the remoteness of its leaflets; and I am unable to say whether or not this variability is dependent on the age and the habitat of the plants. But according to Beccari, this species seems to vary extremely even in Java itself, and so before separating the various forms into distinct varieties, one will have to devote a great deal of time to study the variations due to the age and the habitat of the plants. Some of the Peninsular forms look (*e.g.* Henderson n. 21710) exactly like Beccari's plate of *D. Schmidtianus* from Koh Chang Island off the coast of Siam, while some others (*e.g.* Corner, 30428) like Blume's plate 134, with the exception of the armature of the basal part of petiole, which appears to have been wrongly depicted as having numerous acicular spines; while still others could be easily mistaken for

* A specimen from Wallich's herbarium consisting of a spadix without the outermost spathe is in Martius's herbarium in Munich. From the photograph kindly sent to me by Prof. M. BURRET of the Berlin Herbarium, it appears to be the subject of Martius's plate 117 fig. I.; but I am unable to decide whether the specimen is really *D. melanochætes,* and not *D. grandis* which also has its second spathes somewhat similarly armed. The plate of Martius depicts the thorns on the second spathes with very much swollen bases as in *D. grandis,* whereas the second spathes in *D. melanochætes* and *D. intermedius* have thorns less tumescent at base.

D. intermedius or *D. monticolus;* in fact so great is the resemblance of the armature and shape of some spadices in our material to Griffith's plate 211-B (*D. intermedius*) that I had at first thought to have recognized the latter in *D. melanochætes*. But Griffith's plant is at once distinguished in having peduncled spadices and in being quite bare on the peduncle as well on its portion that is decurrent on the sheath. These characteristics were described for *D. intermedius* by Griffith and can be noticed both in Griffith's plate and the type specimen preserved in the Calcutta herbarium. On the other hand the spadices in *D. melanochætes* are sessile and thickly armed with nigrescent spines up to the base and often also on the decurrent peduncular part.

The Bornean material cited above was referred by Ridley to *D. monticolus,* a species Merrill credited for Borneo on Ridley's authority. Beccari suggested the possibility of the material belonging to *D. Hallierrianus*; and indeed Beccari's plate 99 fig. 3, which is of the specimen collected by Hewitt in Quop, seems represent *D. melanochætes*.

Possibly Ridley's n. 11461 from the Government Hill in Penang also belongs here, but the petiole is not typical.

The beak of spadices may be longer or shorter than the body. The fruit scales are arranged in 15-19 vertical series.

XII. Dæmonorops monticolus (Griff.) Mart., Hist. Nat. Palm, III (1850) 328 t. 175 f. v; Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 465 et in Rec. Bot. Surv. Ind. II (1902) 221; Ridle., Mat. Fl. Mal. Pen. II (1907) 176 pro parte et excl. specimina borneensia; Becc. in Calc. Ann. XII (1911) 84 excl. specimen Ridleyanum; Ridl., Fl. Mal. Pen. V (1925) 37 pro parte.

Calamus monticolus Griff. in Calc. Journ. Nat. Hist. V (1844) 90, Palms Brit. Ind. (1850) 97 tt. 214 A, B, & C (excl. spec. pinangense) Type locality = Malacca).

D. angustifolius Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 176 et Fl. Mal. Pen. V (1925) 36 pro parte. **Syn. nov.**

D. monticolus var. *pinangianus* Becc. in Calc. Ann. XII (1911) 85 quoad tabulam Griffithianum. **Syn. nov.**

Malay Peninsula: **Malacca,** Bukit Dusun Paya (Alvins, 1217, vern. name *Rotan Miniak*). **Negri Sembilan,** Gunong Tampin (Goodenough, 1857).

The two specimens cited above agree very well with Griffith's plate and specific description and represent a species likely to be confused with *D. Lewisianus* from Penang (as Griffith had done). The authentic specimen in the Calcutta herbarium appears to be the Penang specimen that was referred here by Griffith in his second work, and which I cite under *D.*

Lewisianus. The Malacca species, *D. monticolus*, seems to be closely related to the latter, but the absence of leaf-sheaths and petioles in the two specimens at my disposal precludes a deeper inquiry into the affinities existing between the two species.

Beccari interpreting *D. monticolus* attached undue importance to the following words in Griffith's Latin diagnosis: *"spatha extima secus carinas duas spinis gracilibus deflexis armata"*; for this description, if taken to mean that the spines are present only along the two carinæ, corresponds neither to Griffith's description in English, nor to his plates 212-B and C. The English rendering of the description of the outermost spathe runs thus:—*"The outer one [spathe] 16–17 inches long, bicarinate, armed between and along the carinæ with weak long, subulate, deflexed, black spines"*:

In view of this I regard both Griffith's plates as representing the typical plant.

At first sight, *D. monticolus* might be mistaken for some forms of *D. melanochætes* and for *D. intermedius*, and in fact Griffith's plates of the last and the first mentioned species show many points of resemblance. But unlike that of *D. intermedius* or of *D. melanochætes* the second spathe of *D. monticolus* is unarmed, or armed only with a few bristles here and there towards the apex and along the carinæ, a probable reason why the species was confused by Griffith himself with *D. Lewisianus*. The peduncular portion may be armed or unarmed.

Both the specimens quoted above were cited by Ridley under *D. angustifolius*. See also my remarks under *D. melanochætes*, *D. grandis*, and *D. Lewisianus*.

XII. Dæmonorops pseudo-sepal Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 465; Ridl., Mat. Fl. Pen. II (1907) 180; Becc. in Cale. Ann. XII (1911) 79 t. 25; Ridl., Fl. Mal. Pen. V (1925) 40 inter species dubias.

D. bakauensis Becc. in Calc. Ann. XII (1911) 221 t. 100 **Syn. nov.**

Malay Peninsula: **Johore,** Pulau Tinggi (Burkill, 866).

Sumatra: **Banka Archipelago.** Bakau Isl. (Teysmann, herb bogor. n. 277, type of *D. bakauensis*, vern name *Rotan* Rundang); Banka, on Bukit Tampang, near Sungei Liat (Bünnemeijar, 1736, vern. n. *Rotan rondang*); Banka by Sungei (Teijsmann, herb Bogor. n. 269, bern n. *Rotan Rundang*); Banka on Gunong Menumbing, near Muntok (Bünnemeijer, 1465, vern name *Rotan Getah*). (All the Sumatran specimens are from the Buitenzorg herbarium).

The species appears to represent a form midway between *D. Lewisianus* and *D. grandis*. In fruits and in the armature

of its leaf sheath, the species resembles very much *D. grandis*, but the leaflets are much narrower and the spadices shorter. The species should be included among the *Dæmonorops* having sessile or subsessile spadices, and not among those which have stalked spadices. Judging from the outermost spathe present in Bunnemeijer's 1736, the species appears to be closely related to *D. Binnendijki* Becc.

Beccari separated *D. bakauensis* from *D. pseudosepal* because of the broader leaflets and smaller, ovoid fruits in the former; but the fruits in the type specimen are young. Bünnemeijer's specimen 1465 shows both kinds of leaflets and the fruits which are better developed than in the type of *D. bakauensis* are spherical as in *D. pseudosepal*. In view of this I do not see any reason to maintain *D. bakauensis* as a good species.

XIV. Dæmonorops sepal Becc. in Hook. f., Fl. Brit. Ind. VI (1893) 469 et in Calc. Ann. XII (1911) 77 t. 24; Ridl., Fl. Mal. Pen. V (1925) 36.

D. aciculatus Ridl., Mat. Fl. Mal. Pen. II (1907) 176 et Fl. Mal. Pen. V (1925) 38; Becc. in Calc. Ann. XII (1911) 231 inter species dubias. **Syn. nov.**

D. angustifolius Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174 quoad syn. *D. sepal* Becc.

D. calicarpus Mart. *sensu* Ridl., Mat. Fl. Mal. Pen. II (1907) 174 et Fl. Mal. Pen. V (1925) 37 pro parte. **Syn. nov.**

D. hygrophilus Mart. *sensu* Ridl., Fl. Mal. Pen. V (1925) 40 pro parte. **Syn. nov.**

D. imbellis Becc. in Rec. Bot. Surv. Ind. II (1902) 220; Ridl., Mat. Fl. Mal. Pen. II (1907) 179; Becc. in Calc. Ann. XII (1911) 80 t. 26; Ridl., Fl. Mal. Pen. V (1925) 41 inter species dubias. **Syn. nov.**

Malay Peninsula: **Perak,** Gunong Hijau (Ridley in 1892, female. Syntype of *D. aciculatus*); *ibid.*, southern summit, alt. 4,300 ft. (Burkill and Haniff: 12763; 12944); Sungei Mengkarau in Larut Hill (Anderson: 176; 166); Maxwell Hill (Ridley, in June 1893, male. Syntype of *D. aciculatus*). **Selangor,** Sempang Mines (Ridley, 15876). **Pahang,** Sungei Lemoi at Ulu Anak (Dolman, 28157); Cameron Highlands by Sungei Ikan near Ulu Telom, alt. 4,500 ft. (Dolman, 27631, vern. name *Rotan Baik*); Fraser Hill alt. 4,000–4,370 ft. (Burkill. and Holttum, 7785).

The fruiting specimens may be arranged in three classes according to the number of the series into which the scales are arranged on fruits, *viz*:—

(*a*) 15 series: Burkill and Haniff: 12944 and 12763.
(*b*) 15–17 series: Ridley on Gunong Hijau; Dolman: 28157 and 27631.
(*c*) 18 series: Anderson 176.

The fruits in Burkill and Holttum, 7785 are injured and so the number of the scale series cannot be counted. Anderson's 176 bear some fruits which are globose as in Beccari's plate of *D. Scortechinii*, though other fruits are normal. This shows the possibility of *D. Scortechinii* being but a form of *D. sepal*. Ridley's specimen from Gunong Kledang has a very diffuse spadix in fruit resembling that of *D. imbellis*. Some spadices I have seen are distinctly ventricose and nodding, some straight and not so ventricose. I think this variability is due to the vigour of the plants and of the spadices.

Ridlev based his *D. aciculatus* on two specimens he had collected in Perak. He gave the length of the peduncle as 4 inches, misjudging as free the decurrent portion of the peduncle that has become detached off the sheath on being pulled in the living state. The actual length of the peduncle in Ridley's specimens is about 3–4 cm. only. But the species itself is very variable in respect to the length of peduncles. In the Maxwell Hill specimen quoted above the spadix bears a peduncle which is somewhat longer than in all the others I have so far examined, and apparently is nodding as in *D. imbellis;* in some other specimens the peduncle is subsessile or hardly measurable. This variability in length of peduncles and in the number of the vertical series into which the fruit scales are arranged, as well as a comparison of the plates 24 and 26 given by Beccari with the specimens in the Singapore herbarium lead me to consider *D. aciculatus, D. imbellis,* and *D. sepal* as conspecific.

XV. Dæmonorops sepal var. **pahangensis** Furtado **var. nov.**

A forma typica spatha infima aculeis subulatis vel setiformibus appressis vel arrectis atro-fuscis densissime armata (spatharum *D. melanochætes* Bl. instar) hæc varietas differt. Fructuum squamæ per series verticales 18 imbricatæ.

Malay Peninsula : **Pahang,** Fraser Hill, alt. 4,000 ft. (Nur. 11208. Holotype in Singapore).

The petiolar and laminar portions, present in the specimen, appear to be of the radical leaves. The petiole, which is covered with brown indumentum, bears long and short spines all over on the dorsal side, the longest spines being 3 cm. long. At the mouth of the sheath the spines are still longer (up to about 6 cm.). Leaflets about 40 cm. long. 2.5 cm. wide, unarmed beneath or occasionally with a few prickles in the apical half of the midrib beneath; in the upper surface the 4 lateral nerves, and occasionally the mirdib also, are remotely setulose. The spadix with its fruits is like the typical of *D. sepal*.

D. sepal is a long climbing rattan; but this variety has been noted by the collector as short stemmed plant. The collector's notes run thus : "Stem short, heavily armed with straight spines.

Leaves 6–7 ft. long, armed with straight spines. No leaf-flagellum. Fruits pale green edged brown." Further field observations are needed to see whether this variety represents *D. sepal* in the early stages of its development, for I note in the apical parts of the outermost spathes a tendency for the softer bristles to fall off and become like that of *D. sepal.*

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Abrams s.n.-X. **Alvins:** 979-III; 980-VI; 1217-XII; 1878-VI. **Anderson:** 166 & 176-XIV. **Bunnemeijer:** 1465 & 1736-XIII; 7016 & 7451-X. **Burkill:** 376-X; 866-XIII; 983 & 1016-XI; 1372-VI; 2551-VI; 6520-VII; 6536-VI. **Burkill & Haniff:** 12763 & 12944-XIV. **Burkill & Holttum:** 7785-XIV. **Corner:** s.n.-I; 12749-I; 29750-VII; 30077 & 30389-III; 30428-XI; 30447-VII. **Curtis:** s.n.-V, X, 764-X; 2232-X; 3160-III; 3351-X 3444-III & X. **Derry:** 108 & 110-VI; 112-III. **Dolman:** 27631 & 28157-XIV. **Elmer:** 21102-XI obs. **Fernandez:** s.n.-VII & VIII. **Fox:** 11299-I. **Gaudichaud:** s.n.-II. **Goodenough:** s.n.-VI; 1660-VI; 1857-XII. **Grashoff:** 196 & 639-VII. **Griffith:** s.n.-I & X. **Henderson:** 18358-XI; 19484-VI; 21710-XI; 24620-I. **Herb. Bogor.** *nos.* 222-VII; 269-XIII; 404-VII; 468-IX. **Hewitt:** s.n. R.A.-XI. **Heyne:** 2548-VII; 2670-IX. **Holttum:** 9561-XI; 9778-VI. **Lewis:** s.n.-X. **Mat:** s.n.-VI. **Nur:** 11208-XV; 18891-XI. **Ridley:** s.n.-I, III, VI, VII, X, XI, XIV; 3498 & 3499-VI; 3506-VI; 4622-I; 5122-VI; 5123-I obs. & VI; 5124-VI; 6279-I; 6672-VI; 7002-II; 7003-X; 7034-X; 7100-XI; 7102-X; 7878-III; 7880-I; 7895, 7896 & 7897-X; 7899-III; 7900 & 7902-X; 8957-VI; 9466-X obs. & XI; 11203-VIII & XI; 11461-XI obs. 11826-826-VII; 11983-I; 13302-I & IV obs.; 14115-III; 14719-I & VII; 15876-XIV. **Seimund:** s.n.-X. **Teijsmann:** 269 & 277-XIII.

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PALMÆ MALESICÆ.

VII.—Two new CALAMI from the Buitenzorg Gardens.

By C. X. Furtado,

Botanic Gardens, Singapore.

Early this year (1936) I noticed cultivated in the Botanic Gardens, Buitenzorg, Java, two *Calami* showing some characters that are rather infrequent in the genus, and on further study both proved to be new. The one, *C. Steenisii*—named in honour to Dr. C. G. G. J. van Steenis of the Buitenzorg Herbarium, who had taken a great deal of trouble to facilitate my studies during my visit to the Gardens—is recorded to have been introduced from New Guinea, and possesses so many anomalous characters that it cannot be made to fit in any of the sixteen groups into which the genus *Calamus* has been divided by Beccari (*Ann. Roy. Bot. Gard., Calcutta*, XI, 1908, pp. 64–69), though it shows, at the same time, several marks of affinity to some of the New-Guinean species belonging to *Group V* (*vide infra*). The second, described here as *C. inopitatus*, is of unknown origin. It is a stemless palm and produces leaflets which are covered in the under surface with minute pinkish tomentum, both of which characters are not common in the genus. It is closely related to *C. Burckianus* Becc. from Java, a member of *Group II* of Beccari and possibly also stemless.

Calamus Steenisii Furtado **spec. nov.** (*Planta fœminea tantum visa*). *Caudex* soboliferus, alte scandens, circ. 17 m. longus, cum vagina 2.5 cm. in diametro. *Vagina* frondium flagellifera, infra petiolum gibbosa, furfureo ferrugineo, deciduo, dense leprosa, aculeis numerosissimis, tenuibus, applanato-acicularibus, primum ferrugineis, mox lævigatis, stramineis per series transversales interruptas, 3–5 mm. inter se remotas dispositis, basi connatis, in partibus liberis fragilibus armata. *Ochrea* papyracea, exsuccosa, fibrosa, auriculo-lanceolata, circ. 50 cm. longa, e basi 2.5 cm. lata in apicem acuminatissimam interdum fissam transiens, intus lævigata, extus obscure bicarinata, deciduo fusco leprosa, spinis, flaccidis, laminaribus, exsuccosis, solitariis, vel basi connatis, ad 6 mm. longis prædita. *Petiolus* subtus convexus, usque geniculi basin inermis, supra applanatus, basin versus concavusculus, secus margines aculeis 3–4 mm. longis, rigidis per tres lineas dispositis armatus, furfureo fusco deciduo leprosus, 8–12 cm. longus, ad 1 cm. latus. *Lamina* circ. 1–1.20 longa, ecirrhifera vel interdum in

cirrhum abortivum, filiformem, inconspicuum, sæpe cum segmento terminali adnatum, ad 7 cm. longum exeuns, in rhachi eodemmodo leprosa, subtus secus rhacheos dorsum marginesque aculeis dispersis, reduncis, basi tumescentibus, apice atris, solitariis, interdum transverse connatis armata. *Segmenta* plura, untrinsecus circ. 50, alternantia vel subopposita, ad angulum 45° divergentia, lineario- ensiformia, maxima latitudine in media sita, circ. 20–23 cm. longa, 12–15 mm. lata, acuminata, basin versus attenuata et in marginibus crispata, infima subito oblique contracta, ad margines subtus secus costam mediam tantum et supra ad costas tres setulosa. *Inflorescentiæ fœminæ* foliis longiores, circ. 2 m. longæ, flagelliformes, in axi aculeis reduncis, solitariis vel digitatis, rigidis, ad 5 mm. longis armatæ, deciduo furfuraceæ, in ramos primarios 2–4 divisæ, pedunculo ancepiti, secus margines præsertim aculeis minutis prædito suffultæ. *Rami primarii* ad spatharum os orientes, statu juvenili in lobo spatharum libero obtecti, circ. 30 cm. longi, spiculas utinsecus 5–7 ferentes. *Spathæ: primariæ* basi tubulosæ, cylindricæ vel ancepites, aculeis dimensione variabilibus, ad 3 mm. longis rigidis, raro digitatis armatæ, apice in lobum, liberum, mox marcescentem, parce aculeolatum, in parte summa fere inermem, interdum fissum, in modo auris asini productæ; *secundariæ* perbreviores, circ. 2 cm. longæ, papyraceæ, infundibuliformes, in lobum acuminatum unilateraliter productæ, parce aculeolatæ. *Spiculæ* ad spantharum os secundarium orientes, axi flexuosæ, 8–12 cm. longae, florum glomerulos distichos, alternatos gerentes. *Spathellæ* infundibuliformes, oblique truncatæ, acuminatæ, aculeolis perbrevissimis, rigidis, basi tumescentibus scabridæ. *Involucrophorum* cupulare. *Involucra* profunde cupularia, in singulo involucrophoro germinata, connata. *Flores* ad singula spathella germinati, ambo fœminei vel in parte spicularum apicali alter neuter (masculus?). *Perianthium* fructiferum pedicelliforme vel subpedicelliforme. *Fructus* immaturi tantum visi, ovoidei, circ. 12 mm. alti, 6–7 mm. crassi, squamis per series verticales 18–22 dispositis, concoloribus, stramineis. *Albumen* homogeneum.

Patria: Nova Guinea borealis.

The plant described here is cultivated in the Botanic Gardens, Buitenzorg, under the gardens' no. X.E. 2, and is said to have been introduced from the northern parts of New Guinea. The herbarium collection studied by me bears the Singapore Field No. 30840. The holotype is preserved in the Singapore herbarium, and the isotypes will be distributed to the herbaria of Buitenzorg, Leiden, Kew and Berlin.

The edges of the leaflets are slightly turned upwards. Judging from the marks of the fallen flowers and fruits, it

appears that the two female flowers are borne at each spathel except in the distal ends of the spikelets where one neuter (or male?) and a female occur at each spathel.

It is extremely difficult to make this species fit in any of the sixteen groups into which Beccari has subdivided the genus *Calamus*. If the presence of the long dilated, auriculiform, free apical extension of the primary spathes is disregarded, the species would certainly fall into the *Group V*. Further the scabridity on the spathes and spathels would place *C. Steenisii* into the *Group V*-A, of which sub-division no species is known to occur in the part of the Indonesia lying to the east of Borneo. No member of this group is known to possess very long ocrea at the mouth of the leaf-sheaths, a character which, if one disregards the abovementioned scabridity, would put the species into the *Group V*-B, and precisely in the section which includes the species that occur in New Guinea alone.

But if the dilated ends of the primary spathes are taken into consideration, two *Groups VI and XVI* may partly lay claim to this species, though again no species belonging to both these groups are known to occur eastwards beyond Borneo. All the species of *Group VI* have spathes which split or open longitudinally almost down to the base into loriform laminæ. The species of *Group XVI*, though have the primary spathes similar those in *C. Steenisii*, differ from the latter in that they all have very much compressed, short spadices and ruminate seeds (*C. Steenisii* has very long spadices and non-ruminate seeds).

All this suggests the necessity of redefining *Groups V, VI and XVI*, or of creating a new one so as to keep several of the New Guinea species together and to include such species which, together with *C. anomalus* Burret, *C. Lauterbachii* Becc., *C. nannostachys* Burret, and *C. Steenisii*, cannot be made to fit definitely into any of the sixteen groups of Beccari, though all of them show marked affinities to the species in the three groups referred to above.

Calamus inopinatus Furtado **spec nov.** (*Planta mascula tantum visa*). *Caudex* soboliferus, acaulis, interdum ad 35 cm. longus, 2.5 cm. crassus, per totam altitudinem radices ærias ad 8 mm. crassas solum attingentes gerens. *Vagina* frondium 10–15 cm. longa, haud flagellifera et non gibbosa, in latere ventrali ad basin usque vel fere aperta, in petiolum sensim transiens, aculeis laminaribus, elasticis, ad 5 cm. longis, acuminatis, basi ad 4 mm. latis, digitatis vel interdum per series obscuras dispositis armata. *Ochrea* in modo alæ secus margines vaginæ enata, apice truncata, haud in lobos liberos producta, in alis utraque 6–10 mm. lata, rigida, fragilis, aculeis rigidis, acicularibus, atris, ad 5 mm. longis, basi, per series transversales interruptas connatis prædita, basin versus sensim in vagina evanescens. *Petiolus* 20–30

cm. longus, circ. 6 mm. crassus, teretiusculus, supra anguste canaliculatus, sulcos aculeorum exhibens, aculeis acuminatis, laminaribus, elasticis, stramineis ad 2.5 cm. longis, basi ad 4 mm. latis, apicem petioli versus solitariis, basin versus sæpe digitatis vel oblique subverticillatis. *Lamina* ad 1 mm. longa, imparipinnata vel fere; secus rhacheos dorsum in duabus partibus inferioribus tantum aculeis solitariis laminaribus, distantibus prædita, signis aculeorum conspicuis impressa. *Segmenta* numerosissima, æquidistantia vel fere, alternantia vel subopposita, 3–3.5 cm. inter se remota, ad 35 cm. longa, ad 2 cm. lata, lineario ensiformia, in apicem filiformem, setulosam terminata, intermediaria longissima, subtus roseo-tomentellosa, secus costas tres supra medium vel paulo infra setulosa, supra inermia, lævigata. *Inflorescentiæ masculæ* inermes, haud flagelliformes, frondibus breviores, ad 60 cm. longæ, in ramis primariis 3–4 divisæ, in rhachi spathisque deciduo fusco-furfuraceæ, pedunculo in vagina includente, nonnihil infra ochreæ apicem attigente. *Spathæ: primariæ* plus minusve striatæ, ad 6 cm. longæ, tubulosæ, apice oblique truncatæ, unilateraliter acuminatæ et in altero latere fissæ; *secundariæ* consimiles, æquilongæ vel minores; *tertiariæ* minores, infundibuliformes, acuminatæ, striatæ. *Spathellæ* consimiles, apiculatæ, in altero latere fissæ. *Rami primarii* 10–15 cm. longi, interdum ramus basalis ad 40 cm. longus, nonnihil infra os spatharum inserti, in ramos secundarios, interdum tertiarios, eodemmodo infra orificium spatharum orientes divisi. *Spiculæ* prope basin spatharum orientes; primariæ ad 9 cm. longæ, basin versus secundarias 2–3 cm. longas sæpe ferentes. *Flores* solitarii, alternati, confertissimi, ex spathellis usque duas partes exserti, in involucro profundo cupulari insidentes, utrinsecus in speculis primariis ad 15, ac in secundariis 9–12, ad 4 mm. longi, petalis sesqui longioribus quam sepalis, ambobus striatis, ovato lanceolatis.

PATRIA : ignota.

The plant is cultivated in the Botanic Gardens, Buitenzorg, and bears the gardens' no. X.E. 24. The specimens described here were collected by me under the Singapore Field number 30919. The holotype is preserved in the Singapore herbarium. Duplicates will be distributed to the herbaria of Buitenzorg, Leiden, Kew and Berlin.

This peculiar species belongs evidently to the *Group II* of Beccari and seems to be closely related to *C. Burckianus* Becc. from Java, which is probably also a stemless species; but it is described to have its petiole unarmed, leaf rachis unarmed or armed with small claws beneath, and the primary (three) costæ of the leaflets setose above and sometimes also beneath, whereas *C. inopinatus* has its petiole and rachis of the leaves armed with

rather long, laminar spines, its leaflets quite smooth above but armed along the three ribs beneath, as well as covered with minute, pinkish tomentum in the lower surface. The only other stemless *Calamus* is *C. pygœus* Becc., a species belonging to the *Group V* of Beccari and, therefore, differing in its spikelets and spadix-branches being sessile, that is, arising at the mouth of their respective spathes.

ON THE APPLICATION OF THE TERMS MALAYSIA AND MALAYA IN PLANT GEOGRAPHY.

By C. G. G. J. van Steenis,

Buitenzorg, Java.

There is rather a lot of confusion about these terms, as pointed out by Haviland (1) so long ago as 1897.

The Malayan language is properly limited to Western Malaysia (Sumatra, Banka, Billiton, Riouw, Lingga, the Malay Peninsula and Anambas-Natoena Islands). It is in common use over the whole of the Netherlands Indies, originally on account of the seafaring habit of the Malays, who introduced their language along all coasts. Hence, the extremely wide distribution of the common Malay language. As soon as one meets inland people, one finds local dialects and languages.

Already H. Zollinger (2) had a good idea of the use of the word Malaysia (Malesia in Latin and German). He rightly proposed to indicate the whole of the tropical flora between Asia and Australia (including the Malay Peninsula) by the word Malaysia.

The Rev. J. E. Tenison-Woods published in 1889 an essay "On the Vegetation of Malaysia" (3). This is principally concerned with the Malay Peninsula, but it is clear from the text that he used the term Malaysia in a wider sense, though he did not define it exactly. He consistently used the term Malay Peninsula when referring to that area only, and other resident botanists have usually done the same. They tend to avoid the use of the word Malaya, but the term British Malaya is sometimes used. Recently H. J. Lam (4) used the latter term, but in the same article used also the term Malay Peninsula.

H. N. Ridley (5) used in general the term Malay Peninsula or Malaya for the Peninsula south of 7°, and Malay Islands for Netherlands India. Most other authors however follow Zollinger's proposal, made 80 years ago, and repeatedly advocated by E. D. Merrill (6), H. Bancroft (7), myself (8), H.J. Lam (4), and others.

F. N. Chasen (9) uses the term Malaysia to comprise only the Sunda shelf (Malay Peninsula, Borneo, Sumatra, Java, with the intervening small islands); Boden Kloss also used the term in that sense.

This is in slight contrast with the terms used by Zollinger (2), Merrill (6) and I. H. Burkill (10) who call the Sunda shelf region Western Malaysia, in contrast to the Sahul shelf which they indicate as Eastern Malaysia. It must be

said, that ZOLLINGER did not include the whole of New Guinea in his Malesia, but only its westernmost part. This is doubtless to be ascribed to the inadequate knowledge of the Papuan flora at the middle of the 19th century.

Several botanists, *e.g.* BECCARI in his "Malesia" exclude New Guinea from Malaysia, but include Assam, Burma and the Andaman Islands. The same view is held by ENGLER (11), WARBURG (12) and others who include in Malaysia the Indo-Chinese Peninsula, in contrast with ZOLLINGER (2), BURKILL (10) and RIDLEY, who take the NW. boundary of the true Malaysian stock at about 7° N. across the Siamese isthmus, where a rather abrupt change in flora is indicated.

Though nowhere in the world can absolute, pure and abrupt floral regions be distinguished, and gradual transition is the general rule, there is good reason to speak of an Indo-Malayan flora, comprising S.E. Asia and the Indo-Malayan Archipelago, which falls into two subregions; the Indian flora and the Malaysian flora, the latter having a common stock distributed from the Malay Peninsula as far as New Guinea. According to HOOKER, BENTHAM and others the Australian flora is also a modified part of the Indo-Malaysian stock but this dates back to the far past and Australia is to be distinguished nowadays as a separate centre.

Uniformity in the use of the terms, both geographically, historically and phytogeographically, is much to be desired. There are ample reasons for the following definitions:

MALAY PENINSULA, comprising the Malay States and Straits Settlements, is a *topographical* term. In phytogeographical sense its N. boundary is situated at ca. 7° N.

MALAYSIA includes the whole of the Netherlands Indies, Philippines, the Malay Peninsula, Sarawak, Br. N. Borneo, Brunei, Portuguese Timor, Christmas Island, and the whole of the island of New Guinea (Papua). It is a *biogeographical* term.

MALAYA is according to Mr. FURTADO and myself a word which is ambiguous and likely to cause confusion, especially to non-British botanists. There have been made several attempts to restrict it to mean "Malay Peninsula", but even today writers of local history and folklore have to define the word to show what they mean. Only a few years ago the term "Malaya" included Sumatra, Borneo, Rhio Archipelago, etc., so that the use of the term "British Malaya" was not uncommon and was used even on the survey maps of the Peninsula, and there are still books in the Malay Peninsula like "Official Guide to British Malaya". For phytogeographical purposes it would be better to use the word Malay Peninsula and to avoid on the whole the single term "Malaya" which can only give rise to confusion.

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THE GENUS LOMAGRAMMA

By R. E. Holttum

1. Historical.
2. Biology and Morphology.
3. Essential characters of the genus.
4. Distribution, and status of species.
5. Excluded species.
6. Keys.
7. Description of species (alphabetical order).
8. Species dubia.
9. Doubtful specimens.

1. HISTORICAL

Among the curious groups of climbing ferns of the Eastern tropics, Lomagramma seems to have attracted little attention, and there is no general account of the genus, chiefly perhaps owing to the inadequacy of collections. The various species, as indicated below, have been described by various authors at different times, and in many cases descriptions are very incomplete, so that a comparison based on published descriptions is quite impossible.

My interest in this genus was aroused when I undertook the study of Stenochlæna and the genera confused with it, all of them climbing ferns of similar habit to Lomagramma. I studied these ferns in the field in many places in the Malay Peninsula, and became also acquainted with all the stages of the life history of the two Peninsula species of Lomagramma. I then realised that these climbing ferns (except Stenochlæna proper) have two distinct leaf-forms, produced in response to the two different environments occupied by the plants: the moist shady lower levels of the forest, and the lighter and more airy upper regions reached by the climbing stems. This distinction has not been fully appreciated by most authors, and the low-level fronds have usually been ignored, or regarded as "abnomal". These fronds clearly play an important part in the life of the plants; they have distinctive characters and are important diagnostically. Having discovered these facts by observation of the local species, I feel that I am perhaps in a better position than others to deal with this genus, and have accordingly attempted to piece together an account of it, based upon the available specimens.

The genus Lomagramma was founded by John Smith in 1841 (*Journ. Bot.* 3 : 402). He cited the species *L. pteroides*,

which he based upon Cuming's no. 223, collected in the island of Luzon, and his description is as follows:—

> The single species upon which this genus is founded has the habit of Stenochlæna, but differs in the venation being reticulate. It is distinct in habit from the following, and in the sporangia forming a broad marginal line or sorus; and therefore in that respect partaking of the character of Lomaria, but differing in having reticulate veins, and being without a special indusium.

It is curious that the author should have happened to take as the type of his genus a species which is unique (so far as present knowledge goes) in having a marginal sorus instead of fully acrostichoid fertile pinnæ, and should have based the name of the new genus on that very character.

In his next paper (*l.c.* 4: 152), John Smith gave a further diagnosis of the genus, and added "presumably this fern may be the *Leptochilus lomarioides* of Blume, but his description is too brief to enable me to determine with certainty." The remark about Blume's description is correct. An examination of the types of both species, and of a number of other specimens, leads me to believe however that they are quite distinct; they differ constantly in various characters at all stages of their life history.

John Smith overlooked a yet earlier species, *Aspidium sorbifolium* Willd. This species, based on a young plant, was ignored by most later authors. Christensen in his *Index Filicum* doubtfully identified it with *Lomagramma polyphylla* Brack. Ching, examining the type in the Berlin herbarium, considered it to be identical with *Leptochilus lomarioides* Bl., but I give below reasons for believing him to be mistaken. In my opinion, *Aspidium sorbifolium* is one of the species *L. sumatrana, L. grosseserrata* and *L. Mathewii,* but I do not think it is at present possible to say which. Therefore I leave it as dubious species.

L. pteroides and *L. lomarioides* were lumped together by Hooker in *Species Filicum* under the name *Acrostichum Blumeanum* (*Chilolepton Blumeanum* Fée, based on specimens from Java). Hooker also included a specimen from Samoa, which I now describe as a new species *L. cordipinna.*

The next well founded species was *L. polyphylla* Brack. (1854), a very remarkable outlier in Fiji, having bipinnate fronds. Twenty years later Baker described another peculiar species from the same region, *L. cultrata* (Solomon Islands), having deeply lobed pinnæ, both sterile and fertile; this still remains known only from the original collection.

Beddome came next with *Lomagramma perakensis* (1892), a very distinct species from the mountains of the Malay Peninsula. Copeland distinguished the Bornean *L. Brooksii* in 1908; but he appears to have misunderstood the Philippine species in making two new varieties of L. pteroides the same year. Van Alderwerelt van Rosenburg, recognising for the first time that

there were two species of the genus in Java, described *L. abscondita* in 1922; unfortunately he omitted to examine the type of *L. lomarioides,* and the type of *L. abscondita* is identical with *L. lomariodes,* so that the second Java species still lacked a name. Van Alderwerelt described also *L. sumatrana* in the same year; this species occurs also in the Malay Peninsula.

In 1920 Brause described *L. novoguineensis,* a very distinct species from New Guinea. Two years later, Christensen described *L. sinuata,* from a specimen from Celebes; this species is in my opinion represented also in Borneo, East Java, and New Guinea, and our knowledge of it is increased by a recent collection from Java, including bathyphylls, kindly sent to me by Dr. Posthumus. *L. melanolepis* was described by van Alderwerelt from Ternate in 1922; it is probably closely allied to *L. sinuata.*

In 1930 Ching described *Campium Matthewii* from south China. The specimens were clearly bathyphylls of a Lomagramma. Ching subsequently recognised the genus, and regarded the species as identical with *Aspidium sorbifolium* Willd. This however appears doubtful, and I am still in doubt about assigning acrophylls to *L. Mathewii.*

Among the specimens I have examined, there are in my opinion four additional species which I here describe as new: *L. Copelandii,* a common Philippine species which has hitherto not been clearly distinguished from *L. pteroides; L. Merrillii,* an interesting small species from Mindanao; *L. cordipinna* from Samoa; and *L. grosseserrata* from Siam. The lowland species from Java remains unnamed, as it may prove to be identical with one of the species already described. It is likely that there are other distinct bipinnate species in Fiji and neighbouring island groups.

Among the specimens also are several which cannot definitely be assigned to any of the known species, but which are not adequate to serve as types for new species. It is possible that some of them represent bathyphylls of known species, but there are no definite connecting links. A list of these specimens is given at the end of this paper; they are from Celebes, Luzon, New Guinea, and Tahiti.

Ching has included in the the genus a species from South America, *Leptochilus guianensis* (Aubl.) C. Chr. I give elsewhere in this paper my reasons for excluding this species from Lomagramma, which thus appears as a genus extending from Assam and southern China through the Malayan region to the Pacific. Within this region occur also other species which have by some authors been regarded as belonging to Lomagramma but are here excluded, namely *Polybotrya Wilkesiana* Brack. and its allies; these I regard as allied to Teratophyllum.

2. BIOLOGY AND MORPHOLOGY

The species of Lomagramma are very interesting biologically. They are climbing plants, starting life (in all recorded cases) on rocks beside streams in shady forest, and later climbing high up large trees. As with some other climbing plants, the fronds they hear in their low creeping condition are different from those borne by the high-climbing stems. In an account of Teratophyllum, I proposed the name *bathyphylls* for the fronds produced in the low levels of the forest. A term is also needed for the high-level fronds; these will be called *acrophylls,* a term suggested to me by Dr. Christensen. There is sometimes more or less of a transition between the two, and there is a further difficulty that the bathyphylls are not all similar, those borne by the very young plants naturally being smaller than those produced later. There is however a real distinction between the two. A plant may go on creeping on the rocks for a considerable period with a quite slender rhizome and fronds which do not increase beyond a certain size. When it starts to climb a tree, the rhizome increases very quickly to a much greater thickness, and bears the much larger acrophylls. The production of fertile fronds appears in most species to be rather infrequent, or possibly seasonal; at least in the Malay Peninsula, where we have relatively slight seasonal change, fertile fronds have rarely been found. Probably, as in Stenochlæna and other ferns, the fertile fronds are produced during dry seasons. I once found fertile fronds of *L. sumatrana* on a plant which had been suddenly exposed by the fall of a neighbouring tree; this may have had a similar effect to that of a dry season. The spores are very thin-walled, without perispore. They appear unlikely to be able to withstand dessication, and the character may be connected with the streamside habitat of the plants.

The acrophylls of all species except *L. polyphylla,* and *L. cultrata* are simply pinnate with almost entire pinnæ. They are thus all very similar, differing in rather small characters, and some not very easily distinguishable. On the other hand, the bathyphylls are usually much more distinct, and from my field observations of the Peninsula species, and herbarium study of the large number of bathyphylls of the unnamed Java species which I have received from Buitenzorg and Pasoerœan, I am convinced that the bathyphyll characters are good and constant. It is of course necessary to compare bathyphylls of similar size.

This state of affairs is almost exactly paralleled in Teratophyllum, and as in Teratophyllum, the earliest stages of growth, bearing immature fronds, are often quite distinctive. Full-size bathyphylls have usually all the pinnæ articulated; but in some species the earlier fronds, of smaller size, have the apex not articulated, but consisting of a narrow lobed lamina continuous with the rachis and different from the lateral pinnæ. I believe this character to be a good one; it certainly is so in the Peninsula

species, which are the only ones of which I have examined all stages in the field. The larger bathyphylls have pinnæ which are characteristic in number and spacing, size and shape, characters of base, margins, apex, texture and venation. The marginal teeth are more pronounced than in the acrophylls. I have not seen bathyphylls of all species; and in some cases, where bathyphylls have been collected separately, I am uncertain to which species they should be ascribed. I have not described them definitely unless I am sure of their species.

3. ESSENTIAL CHARACTERS OF THE GENUS

The essential characters which are common to all species of the genus are as follows:

Rhizome dorsiventral, when creeping slender, when climbing much stouter; the vascular system in section a single ring with several leaf-gaps, the ventral vascular strand (bearing the roots) double; fronds rather distant, especially on the creeping rhizome; surface with several longitudinal ridges, with grooves between them. The ridges are pale in colour in the living rhizome. They are decurrent continuations of the bands of aerating tissue on either side of the stipe; beneath them are gaps in the cortical sclerenchyma.

Scales abundant on younger parts of rhizome, and on young stipes, rachis and lamina, all similar in structure but differing in size according to their position; the base of the scales (especially the smaller ones) more or less bullate, the apex narrowed and sometimes acuminate, the cells usually translucent, with thin dark lateral walls; occasionally some of the larger rhizome scales not translucent (*L. sinuata* and *L. melanolepis*).

Stipes with an open ring of vascular strands, to at least 18 in number.

Rachis with anatomy as stipe; more or less winged towards the apex, the wing sometimes almost absent in the largest fronds, and often present throughout the rachis in the smallest.

Sterile pinnæ all articulated to the rachis (except the apex of small fronds of some species); the base rather unequal; the margins more or less toothed; venation without any main lateral veins, consisting of several series of areoles, the costal ones usually largest, without free veins (except sometimes at the margin).

Fertile pinnæ articulated, usually much narrower than the sterile; the lower surface, except for the midrib, entirely covered with sporangia (except in *L. pteroides* where the sporangia are confined to marginal bands towards the base of the pinnæ), the sporangia when young accompanied by peltate paraphyses of the same structure as the scales; the venation as in the sterile pinnæ but the areoles smaller, usually clearly visible on the upper surface.

Spores thin-walled, without perispore or tubercles, usually quite transparent.

The most distinctive of these characters are the scales, the venation, and the spores.

4. DISTRIBUTION AND STATUS OF SPECIES

So far as I can understand, no one species of Lomagramma is very widely distributed geographically as compared with the others. Our knowledge of the geographical distribution may be summarised as follows:

ASSAM, TONKIN & S. CHINA. L. Matthewii.
SIAM. L. grosseserrata.
MALAY PENINSULA & SUMATRA. L. perakensis, L. sumatrana (L. lomarioides in S. Sumatra).
JAVA. L. lomarioides, L. sp., L. sinuata.
TERNATE. L. melanolepis.
BORNEO. L. Brooksii, L. sinuata
CELEBES. L. sinuata.
NEW GUINEA. L. sinuata, L. novoguineensis.
PHILIPPINES. L. pteroides, L. Copelandii, L. Merrillii.
SOLOMON ISLANDS. L. cultrata.
NEW HEBRIDES. L. polyphylla?
FIJI. L. polyphylla, L. cordipinna.
TONGA. L. polyphylla?
SAMOA. L. cordipinna.
TAHITI. Species unidentified, new?

It is evident that much still remains to be discovered regarding these species, especially as regards their distribution. Collections are on the whole meagre, no doubt due to collectors being discouraged from collecting sterile materia[1]. Sterile fronds of Lomagramma (bathyphylls and acrophylls) would usually enable a species to be determined, and would be invaluable as indications of the distribution of the species, and of the constancy or otherwise of characters of the bathyphylls. They would also give definite correlation between the bathyphylls and acrophylls, which is lacking or doubtful in some species.

The species of Lomagramma are certainly closely allied together but I believe that they are distinct, and that sufficient material is available for an account such as the present paper to be of value. It is clear however that to characterise the species fully a description of all stages of their development is necessary. Some species are most easily distinguished in their young stages

or bathyphylls, some in their sterile acrophylls, and some in the fertile fronds. Therefore we shall not have a full understanding of the genus until we know all species in all stages, and we are still very far from this. For the same reason I find it very difficult to construct a key to the species.

Here is one of the many cases in which field observation is essential to supplement herbarium study, and if this paper should reach any persons who may be in a position to undertake such field study, or to instruct collectors, I would appeal to them to bear in mind the case of Lomagramma.

5. EXCLUDED SPECIES

L. guianensis (Aubl.) Ching, Amer. Fern Journ. 22 : 17. 1932.

Leptochilus (Aublet) C. Chr. Index, cum syn.

I examined a specimen of this species at the British Museum. The spores have a large perispore, which I have never found in any species of Lomagramma. Further, the apical pinna is not articulated, but is continuous with the rachis. The venation is connected to typical Bolbitis venation by *Bolbitis serrata,* which has the pinnæ not articulated. In the British Museum Herbarium is also a specimen from Mexico (C. A. Purpus no. 7246); labelled *Leptochilus Turckheimii* C. Chr.; this has main lateral veins as in Bolbitis, but pinnæ articulate. It is evident therefore that the American Bolbitis species have produced a number of variants from the typical condition both in venation and articulation of pinnæ, and I suggest that *Lomagramma guianensis* (Aubl.) Ching is only a rather unusually aberrant species of Bolbitis which simulates the condition found normally in Lomagramma.

Lomagramma Wilkesiana (Brack.) Copel. Phil. Journ. Sci. 3C : 32. 1908.

L. articulata (J. Sm.) Copel. l.c. *L. bipinnata* Copel. Phil. Journ. Sci. 11C: 114. 1916. These three species, and perhaps also *Lomariopsis Balansæ* Fourn. (Ann. Sci. Nat. V, 18 : 271. 1873), evidently all belong to the same genus, but I do not think that they are members of the genus Lomagramma. They have spores with perispore, and their venation is that of Teratophyllum, not Lomagramma. I have not yet been able to examine sufficient material of the species to understand them well enough to found a new genus for them, but I believe that this should be done when the material is forthcoming. The species are in my opinion closely allied to Teratophyllum and could possibly be included in that genus; to do this would necessitate an emendation in the definition of the genus which I gave in this Bulletin, Vol. 5, p. 277, a new section being constituted for the species under consideration.

6. KEYS

Owing to the fact that the species of Lomagramma in some cases differ most strikingly from each other in one only of the three leaf-forms, and also to the fact that in a few cases bathyphylls are still unknown, it is hardly possible to make a satisfactory key. It appears to me more useful to summarise briefly the distinctive characters of the various species under the headings bathyphylls, sterile acrophylls, and fertile fronds; whichever frond-type is then available, this summary should at least locate it within a small group of species, the detailed descriptions of which will provide further information.

BATHYPHYLLS

Pinnæ of largest fronds 25–30–jugate; apex of frond continuous with rachis, except in some of the largest fronds.
- pinnæ entire ... ... *L. lomarioides*
- pinnæ toothed
  - pinnæ to about 2.5 cm. long, drying reddish ... ... *L. pteroides*
  - pinnæ to 5 cm. or more long, not reddish when dry ... ... *L. grosseserrata*, *L. Matthewii*, *L. sumatrana*

Pinnæ of largest fronds 10–18–jugate; apex of frond always an articulated pinna, except in young plants of some species
- pinnæ entire ... ... *L. perakensis*
- pinnæ toothed
  - margins shallowly lobed, lobes about 5 mm. wide, each with 2–4 teeth ... ... *L. Copelandii*, *L. sp.* (Java)
  - margins not lobed
    - upper base suddenly subtruncate from a narrow beginning; lower base very narrow; apex blunt ... ... *L. sinuata*
    - base unequally cuneate; edges sharply serrate; apex acute ... *L. Merrillii*
    - upper base broad subtruncate; lower narrow; edges toothed towards apex; apex in small fronds somewhat rounded ... *L. Brooksii*

Bathyphylls unknown in *L. cordipinna, L. cultrata, L. melanolepis, L. novo-guineensis;* incompletely known in *L. polyphylla.*

STERILE ACROPHYLLS

Bipinnate ... ... *L. polyphylla*

Pinnæ lobed to costa ... ... *L. cultrata*

Pinnæ at most shallowly lobed

Pinnæ, at least of old fronds, subcoriaceous, veins not distinct

Stipes 4 cm. long ... ... *L. Brooksii*

Stipes at least 15 cm. long

Pinnæ to 26 cm. long ... *L. perakensis*

Pinnæ not usually more than 12.5 cm. long

Pinnæ entire ... ... *L. lomarioides*

Pinnæ closely toothed towards apex ... ... *L. Merrillii*

Pinnæ thin in texture, the veins raised and distinct

Pinnæ with a winged stalk to 1 cm. long ... ... *L. sinuata*

Pinnæ hardly stalked

Base of pinnæ cordate, to 2.9 cm. wide ... ... *L. cordipinna*

Base of pinnæ at best subcordate, narrower

Edges deeply crenate-serrate *L. grosseserrata*

Edges not more than slightly toothed

Pinnæ to 11 by 1.3 cm. *L. novoguineensis*

Pinnæ larger, usually to 2 cm. wide

Pinnæ to 18 by 3 cm. edges not toothed *L. Copelandii*

Pinnæ smaller, edges slightly toothed ... *L. Matthewii*
L. melanolepis
L. sumatrana
L. sp. (Java)

FERTILE FRONDS

Fronds bipinnate ... ... *L. polyphylla*

Pinnæ lobed to costa ... ... *L. cultrata*

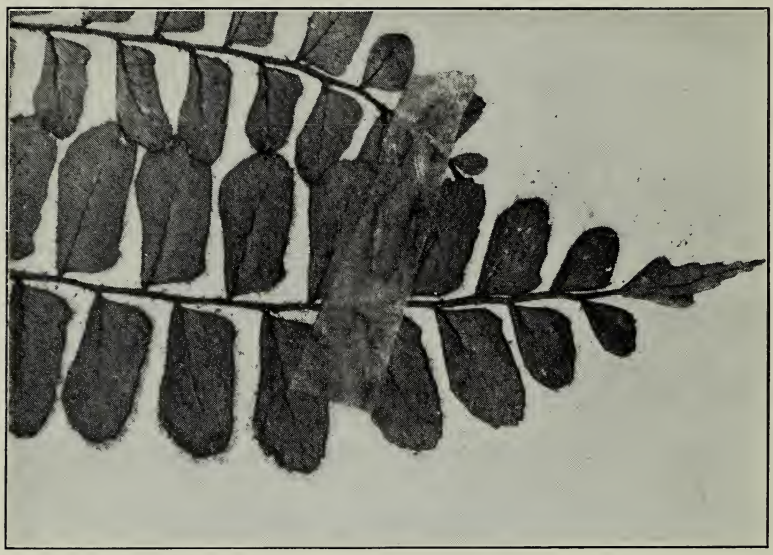
Pinnæ entire

Base of pinnæ always dilated, fertile at the edges only ... ... *L. pteroides*

Base of pinnæ not dilated, whole lower surface soriferous

Widest pinnæ 8 mm. or more wide

Pinnæ about 4.5 cm. long, apex rounded ... ... *L novoguineensis*



Lomagramma borneensis. Above: apex of bathyphyll from young plant (Penrissen, Shelford). Below: apex of full-sized bathyphyll, showing articulated pinna (Holttum 25251). Both x 1.5.

Pinnæ usually not less than 10 cm. long, apex acute ...	*L. cordipinna* *L. grosseserrata* *L. Matthewii* *L. sinuata*
Widest pinnæ to 5 mm. wide	
Pinnæ with stalks at least 3 mm. long	
Pinnæ about 9 cm. long ...	*L. Merrillii*
Pinnæ at least 15 cm. long	*L. perakensis*
Pinnæ almost sessile	
Pinnæ 1–2 mm. wide when dry	*L. lomarioides*
Pinnæ mostly wider ...	*L. Brooksii* *L. Copelandii* *L. melanolepis* *L. sumatrana*

7. DESCRIPTION OF THE SPECIES

In the following pages I have usually given the original description of the species, with an amplified description of my own, based on all material which I have examined. Critical remarks and notes on the diagnostic characters are also included.

For permission to examine specimens, and for loan of material, I am indebted to the heads of the following Herbaria: Buitenzorg (B), Manila (M), U.S. National Herbarium, Washington (W), Kew (K), British Museum (B.M.), Calcutta (C), Pasœrœan (Pas.). The herbaria are referred to by the initials in brackets after the citation of specimens; Singapore herbarium is indicated by the letter S. I am also indebted to Prof. H. J. Lam for the loan of the type of *Leptochilus lomarioides* Bl. and to Dr. L. Diels for a photograph of the type of *Aspidium sorbifolium* Willd.

Lomagramma Brooksii Copel. Phil. Journ. Sci. **3c:** 345. 1908. Also l.c. **7c:** 60. 1912. **Plate 8.**

Rhizomate alte scandente, stipiteque 4 cm. longo paleaceis; rhachi deorsum paleacea, sursum fere glabra et anguste alata; pinnis sterilibus ca. 8 cm. longis, 15 mm. latis, fere integris, coriaceis, nisi ad costas glabris, basibus truncatis, apicibus falcatis breviter acuminatis, venulis immersis, areolis costalibus parvis, lamina viride, venulis infra rubellis; pinnis fertilibus plus falcatis, ca. 3 mm. latis, basibus dilatatis non auriculatis.

Sarawak, Bongo Mountain, leg. Hewitt and Brooks.

Near *L. pteroides* var. *subcoriacea* and *L. perakensis* Bedd. In the specimen sent me the pinnæ are sterile throughout the most of the frond, the apical ones being fertile. The occurrence of sterile and fertile pinnæ on the same frond is hitherto unknown in the genus. It is possibly abnormal in this case, but I believe the species is sufficiently distinct without this character.

In the latter publication above cited Copeland writes: Mr. BROOKS has sent me a very complete specimen, collected at Bau. It has the fertile and sterile fronds distinct, as in other species of the genus. The frond of a juvenile plant "which germinates on the limestone and may grow in large masses before reaching a trunk, and becoming scandent", has membranaceous, serrate, and very oblique pinnæ. Fronds of adult plants are as described, except in size. The sterile fronds are a meter or more long and 30 cm. wide. The fertile frond is still wider, its pinnæ 2 to 4 mm. wide, and straight or curved.

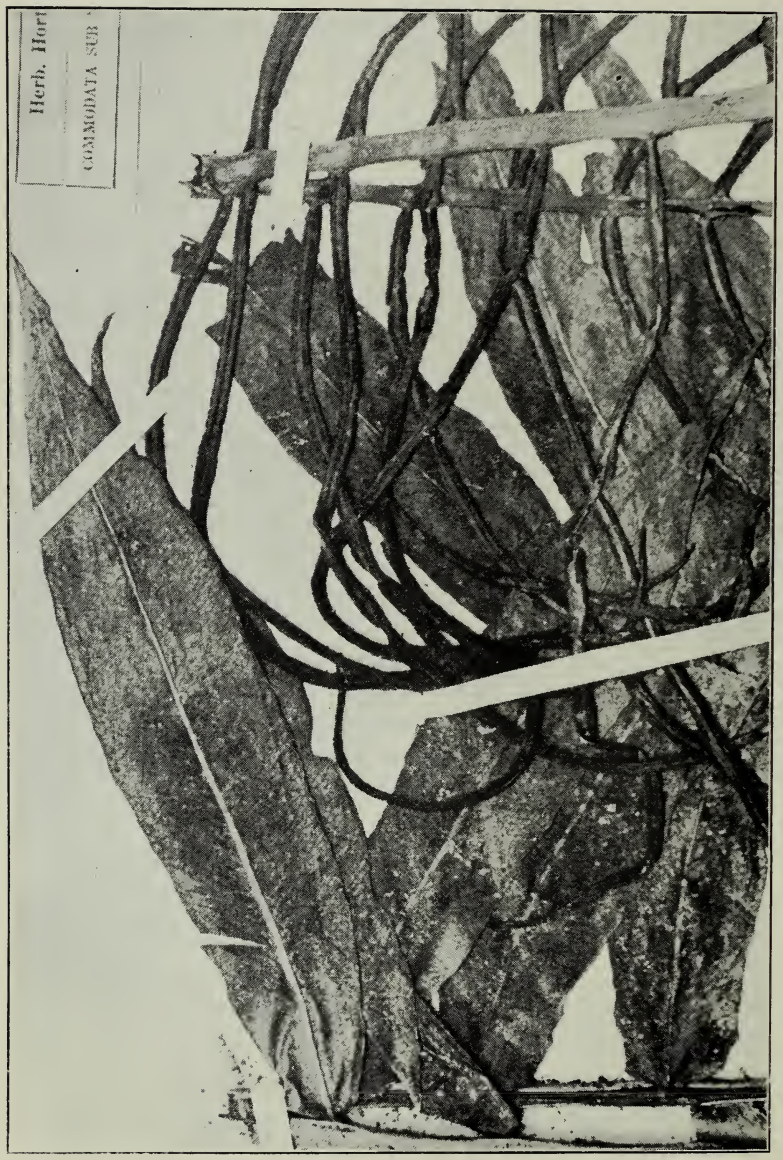
The species is nearest to *Lomagramma perakensis* Bedd, differing conspicuously in the very short stipes and persistent scaliness.

I have not seen the type of this species, but I have seen a considerable number of other specimens from Borneo which clearly belong to one species and agree pretty well with Copeland's description, except that I have seen none so large as indicated by Copeland's note of 1922 and I would not describe the pinnæ of bathyphylls as very oblique. The following description is based on specimens examined by me.

Immature Bathyphylls. Stipes to about 10 cm, fronds up to about 20 cm. long and 7 cm. wide with 12–15 pairs of pinnæ; apex continuous with the rachis; the lower pinnæ at right angles to the rachis, the upper oblique; pinnæ close, largest usually about 4.5 cm. long and 1.5 cm. wide; the upper base broad subtruncate, sometimes slightly auricled; lower base very narrowly cuneate or narrowly rounded in lowest pinnæ; midrib fulcate towards apex; edges toothed towards apex only, apex rounded in youngest plants, usually acute in older ones, width greatest about one third from apex. Texture thin; veins distinct and slightly raised on both surfaces, in 2–3 series of areoles, costal areoles not much larger than others.

Largest bathyphylls. Stipes to 10 cm. lamina to 40 cm. long and 12 cm. wide, pinnæ to at least 18 pairs, uppermost pinna articulate and like the others, largest pinnæ about 6 cm. long and 2 cm. broad, lower base rounded, much narrower than subtruncate upper base, margins toothed towards falcate acute apex.

Sterile acrophylls. Stipes usually about 4 cm. long. Fronds (Copeland's specimen to 1 m. long and 30 cm. wide; largest specimen below cited 75 by 20 cm. Largest pinnæ in middle third of frond, upper and lower gradually reduced. Middle pinnæ at right angles to rachis, to about 2 cm. wide, sessile, lower base a little narrower than the upper, and coming closer to the rachis, rounded to subcordate; upper base subtruncate; edges entire, sometimes wavy especially towards apex, but not toothed; apex acute, gradually narrowed from widest part of the pinna which is usually one third from apex. Texture thin but very firm; veins in three series of areoles, slightly raised and usually quite distinct on both surfaces. The lowest pinnæ usually slightly stalked, the base equal and subcordate.



Lomagramma Copelandii, Type, showing the sessile narrow fertile pinnæ, with base not dilated. 2/3 nat. size.

Fertile fronds. In the specimen seen by Copeland these are more than 30 cm. wide, the pinnæ 2–4 mm. wide. The only fertile fronds seen by me are those of Clemens from Penibukan, Kinabalu; these have stipes to 10 cm. long, and lamina to about 30 cm. long and 10 cm. wide. The pinnæ are up to 7 cm. long by 2 mm. wide, on winged stalks 2 mm. long; the veins usually distinct, the costal areoles elongate, the others almost round.

BORNEO. Kinabalu: Tenompok, 5,000 ft., Clemens 28638 (B); near Dallas, 3,500 ft., S.F.N. 25251, Holttum (S); Penibukan 4,000 ft., Clemens 30636 (M), 5,500 ft. Clemens 50263 (M). Exp. Nieuwenhuis, Jaheri 574 (B). N. Borneo Grens Comm. Amjah 517 (B), 525 (B), 417 (B), 585 (B). Penrissen, Sarawak, Shelford, s.n. 1899 (S, very young).

CELEBES. Menado, afd. Donggala, Kœlawi, 1000 m. Posthumus 2335 (Pas).

This species has been found in various parts of Borneo, and I believe also in N. Celebes; the Celebes specimen consists of rather large bathyphylls, which I cannot assign to any other species. The occurrence of the species in north Celebes, separated by a relatively narrow sea from B. N. Borneo, is not unlikely.

L. Brooksii (as here interpreted) is certainly similar to *L. perakensis* in its sterile acrophylls, differing in somewhat smaller pinnæ of rather thinner texture with more rounded base. The bathyphylls of the two species are very different, those of *L. perakensis* having quite entire pinnæ, the apical one articulate, from a very early stage.

Lomagramma Copelandii Holttum sp. nov. **Plates 9 & 10.**

L. pteroides auctt. p.p. non J. Sm.

L. pteroides var. *negrosensis* Copel. Leafl. Philip. Bot. II: 393. 1908.

A L. pteroidei differt: pinnæ bathyphyllorum maximorum c. 15-jugatæ, ad 6.5 cm. longæ, 1.8. cm. latæ, apicales articulatæ; pinnæ acrophyllorum sterilium ad 18 cm. longæ, 3 cm. latæ, basi superne late cuneatæ inferne rotundatæ, textura tenues; pinnæ fertiles ad 20 cm. longæ, 4 mm. latæ, sessiles, basi non dilatatæ.

Bathyphylls. Stipes from 2 cm. long in fronds of 12 cm, to 18 cm. long in fronds of 40 cm. In fronds to about 15 cm. long apex a narrow lamina continuous with the rachis; in full-sized bathyphylls, apical pinna like others and articulated, but smallest. Bathyphyll pinnæ to about 15-jugate, largest seen 6.5 cm. long, 1.8 cm. wide; base unequal, upper broadly cuneate, lower narrower, rounded except in lowest (somewhat reduced and reflexed) pinnæ in which lower base is narrowly cuneate; edges broadly crenate (lobes to 5 mm.), each lobe with 2–4 short teeth, largest pinnæ toothed only towards apex; apex not falcate, acute in pinnæ of larger fronds, blunt in pinnæ of smaller

fronds; texture thin; veins slightly raised on both surfaces, areoles in two series, costal ones usually largest.

Sterile Acrophylls. Stipe 15–25 cm. long. Pinnæ to 18 cm. long, 3 cm. wide, sessile; upper base usually broadly cuneate to subtruncate, more narrowly cuneate in the upper pinnæ; lower base usually rounded; edges slightly undulate, not toothed; apex acuminate, hardly falcate.

Fertile pinnæ to about 20 cm. long, 4 mm. wide when dry, sessile, the base not dilated, whole lower surface except midrib soriferous, areoles long and narrow.

TYPE. Luzon: Mt. Binuang, Prov. Tayabas, Bur. Sci. no. 28826, Ramos and Edano, in Philippine National Herbarium (duplicate in Herb. Buitenzorg).

This species differs very strikingly from *L. pteroides* in the various characters mentioned in the latin diagnosis. The bathyphylls with their large broad pinnæ are very distinct, being nearest to those of the unnamed species from Java; the pinnæ of sterile acrophylls are very broad and thin in texture, never subcordate as is often the case in *L. pteroides;* the fertile pinnæ are never dilated and partly sterile at the base, and are practically sessile.

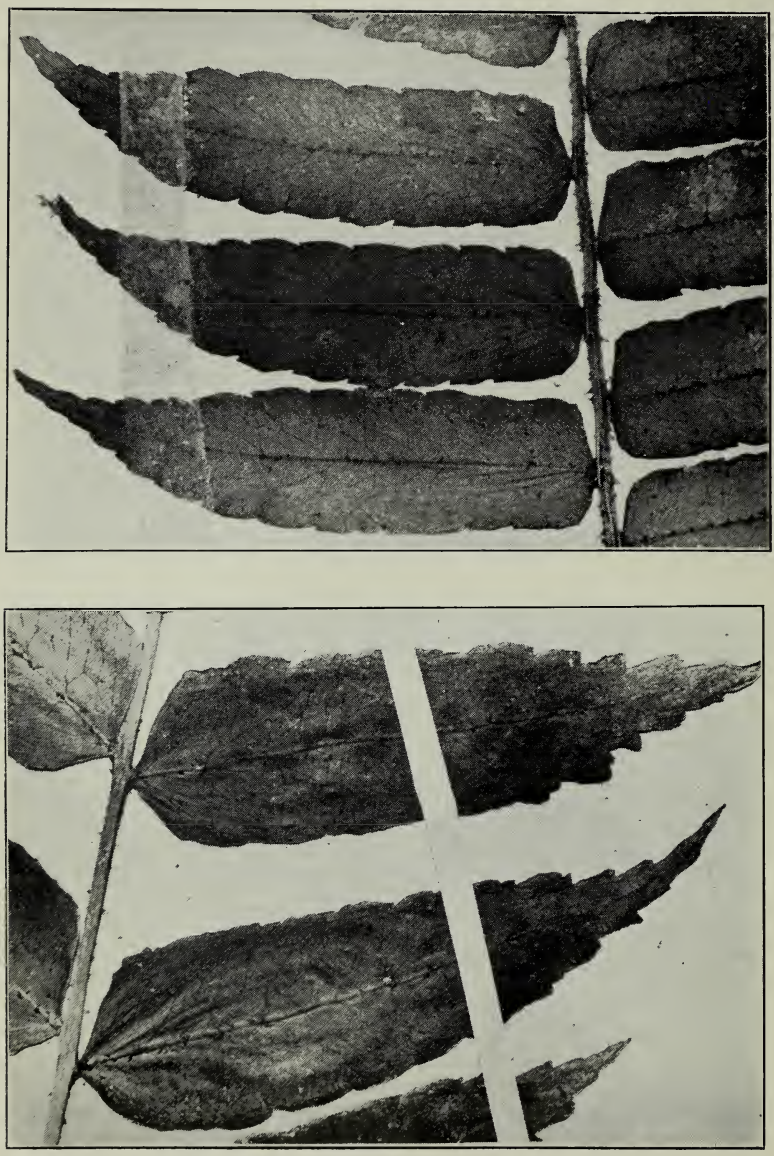
L. pteroides var. *negrosensis* seems to me to belong here, and probably consists of rather small plants of this species, perhaps from a shady place. The specimens show fronds on a rather slender rhizome, the pinnæ about intermediate in size between those of the largest bathyphylls and of the typical acrophylls, and somewhat toothed towards the apex.

L. Copelandii, like *L. pteroides,* is apparently distributed throughout the Philippine Islands. The specimens examined are as follows.

Luzon: Irosin (Mt. Bulusan), Prov. Sorzogon, Elmer 16919 (B, M.); Los Banos, Laguna, Copeland s.n. Mar. 16, 1906 (M, bathyphylls); Infanta, Tayabas Prov. Bur. Sci. no. 9331, C. B. Robinson (M, bathyphylls). *Catanduanes:* Bur. Sci. no. 30358, Ramos (B, M). *Samar:* Catubig River, Bur. Sci. no. 24810, Edano (M). *Bohol:* Bur. Sci. no. 42972, Ramos (M). *Mindanao:* Surigao Prov. Bur. Sci. no. 34816, Ramos and Pascasio (M); Mt. Apo, Cotabato Prov., Phil. Nat. Herb. no. 3244, Copeland (M); Camp Keithley, Lake Lanao, M. S. Clemens s.n. Sept. 1907. *Negros:* Dumaguete (Cuernos Mts), Prov. of Negros Oriental, Elmer 9678 (M, W, B; type of *L. pteroides* var *negrosensis*).

Lomagramma cordipinna Holttum sp. nov.

Bathyphylla ignota. Acrophylla sterilia ad 33 cm. lata; pinnæ mediæ 3.5–5 cm. inter se remotæ, breviter petiolulatæ, ad 17.5 cm. longæ et 2.9 cm. latæ, basi inæqualiter cordatæ vel subcordatæ, margine integræ vel leviter undulatæ, apice



Above: *Lomagramma grosseserrata,* pinnæ of bathyphyll.
Below: *L. Copelandii,* pinnæ of bathyphyll. Both x 1.5.

acuminatæ; textura tenues; venulæ prominentes, areolas 3–4 seriatas formantes; pinnæ apicales minores, basi rotundatæ apice leviter serratæ. *Pinnæ fertiles* petiolulatæ (petioluli ad 5 mm. longi), ad 12 cm. longæ et 1.1 cm. latæ, tota pagina soriferæ.

SAMOA. Pango-pango Bay, W. E. Safford, March 1888, U. S. National Herbarium (Type, 3 sheets). U. S. South Pacific Exploring Expedition 1838–42, s.n. (W).

FIJI. Korumbamba, July 1932, A. Meebold 16856 (B.M.)

This remarkable species is well represented by the fine collections of Safford. Though these include only the central and upper portions of the fronds of acrophylls, the pinnæ are so distinctive that there is no doubt of this being a good species. The cordate or subcordate base of the middle pinnæ, combined with the long-stalked and very broad fertile pinnæ (which are completely soriferous) are the peculiar features of the species.

Of the Fiji specimen, I have seen only a single pinna which I judge to be from the base of a frond; it is short and broad (8 cm. by 3.3 cm.) with almost equally subcordate base and rounded apex, the margins minutely irregularly crenulate towards the apex.

Lomagramma cultrata (Baker) Holttum comb. nov.

Acrostichum cultratum Bak. Syn. Fil. 524. 1874.

Baker's original description is as follows :

A. (*Chrysodium*) *cultratum* Baker; climbs on trees with fronds 6 ft. long; *barren pinnæ* ligulate, 6–8 in long, 1–1½ in broad, cut down to the rachis or a narrow wing into entire close blunt obovate lobes ⅜–½ in broad, cuneately narrowed to a broad base, or rarely produced and oblong, often several of the lower and sometimes the central lobes confluent; *texture* moderately firm; *surfaces* green, naked; *areolæ* small, exappendiculate; *fertile pinnæ* and lobes like those of the barren fronds, but the latter distant, 2–2½ lin. broad.

Hab. San Christobal, Solomon Isles, H. Richards, in Herb. Macleay.

The type sheet at Kew consists of pinnæ only. Most of the lobes are obovate, but some are almost evenly elliptical with a narrow base, almost like separate pinnules but not stalked nor articulate; these elliptical lobes vary in length. The fertile pinnæ are 10–12 mm. broad, the lobes almost circular and rather distant. The scales are typical of the genus, and the spores also.

This species is referred to *L. lomarioides* in Christensen's *Index Filicum*. It seems to me a very distinct and interesting species, a possible link between the pinnate and bipinnate species of the genus.

Lomagramma grosseserrata Holttum, sp. nov. **Plates 10 & 11.**

Species L. sumatrana affinis, differt pinnis acrophyllorum sterilum magnis, longe acuminatis, margine late crenato-serratis, pinnis fertilibus ad 1 cm. latis.

Bathyphylls. Stipes 8 cm. long (in the available specimen); lamina 40 cm. long, 10 cm. wide, lowest pinnæ slightly reduced, reflexed and more separated, upper six pairs gradually reduced; apex continuous with the rachis. Pinnæ 29 pairs, almost touching (except the lowest), largest 5 cm. long and 1.3 cm. wide, at right angles to the rachis, base only slightly unequal, upper base subtruncate, lower broadly rounded, apex slightly falcate acute, edges shallowly crenate-serrate, the teeth 4–5 mm. apart; texture thin translucent; venation in 2–3 series of areoles, the costal ones largest, the veins distinctly raised; scales with bullate base numerous.

Sterile acrophylls. Stipe to at least 20 cm. long. Pinnæ about 3 cm. apart, to about 19 cm. long and 2.5 cm. wide, sessile, the upper base broadly cuneate, the lower rather broadly rounded, margins rather deeply crenate-serrate, especially towards the apex, at intervals of 5–7 mm, the distal third gradually long-acuminate; colour dark dreen when dry; texture thin; veins slender, raised, brown on both surfaces, in about 3 series of areoles; scales numerous.

Fertile fronds. Stipe 18 cm. long. Lower pinnæ on stalks to 5 mm. long, pinnæ to 20 cm. long and 1 cm. wide, the upper pinnæ gradually more shortly stalked and smaller (in the specimen at hand the upper pinnæ are incompletely expanded); colour dark; veins distinct on the upper surface, in about 3 series of areoles, areoles more or less rounded except the costal ones; sporangia covering the whole lower surface except the midrib.

TYPE. Siam: Præ, Me Sai, 620–880 m. Winit no. 1019 (27-11-22), in Herb. Singapore.

This species is clearly allied to *L. sumatrana* and *L. Matthewii,* but it differs in the points mentioned in the diagnosis so strikingly that I cannot but consider it distinct. The bathyphylls are similar to those of the other species mentioned, but they differ from those of *L. sumatrana* in their greater length, and from those of *L. Matthewii* in the greater number of pinnæ, very regular and closely placed. As regards the apex of the bathyphylls, the specimens at hand has indications of articulation, but it is a very large bathyphyll, and I believe that smaller ones would have the apex clearly continuous with the rachis.

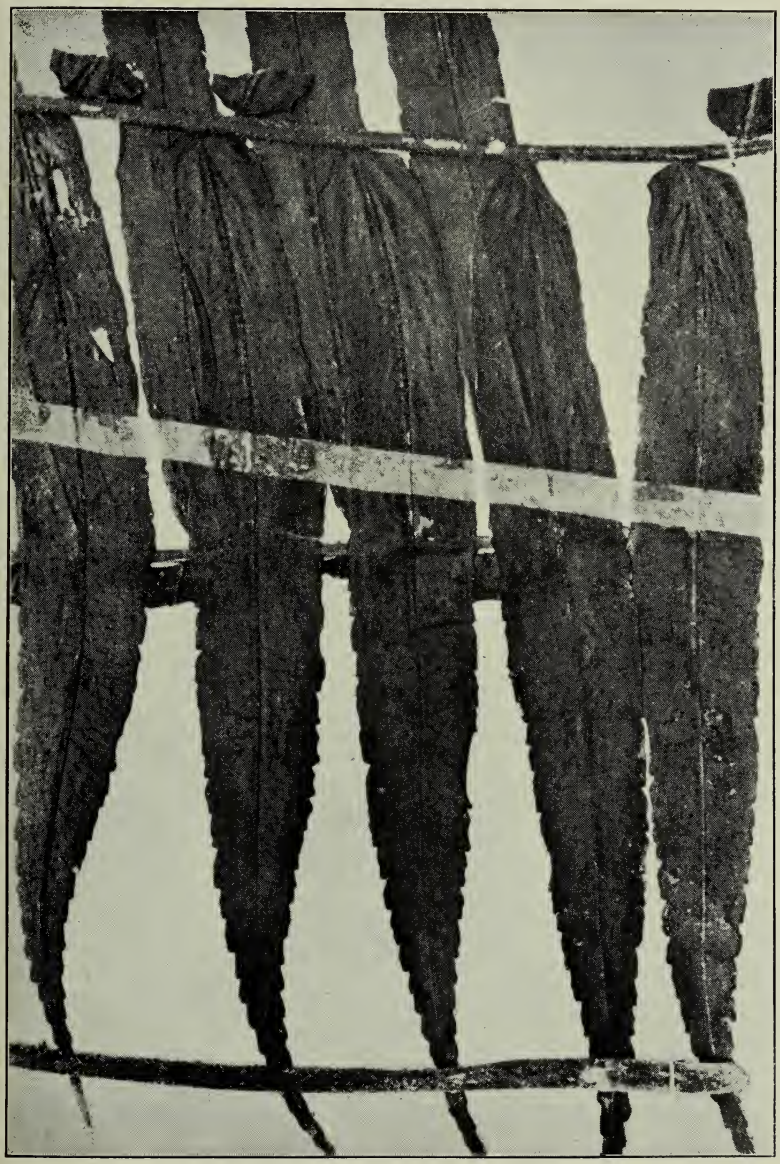
To this species should probably be referred the specimen cited by Beddome on p. 106 of the Supplement to his Handbook (Makum Forest, Lukhimpore, Assam). I have not seen this specimen.

Lomagramma lomarioides (Bl.) J. Sm. Hist. Fil. 143. 1875. **Plates 12 & 13.**

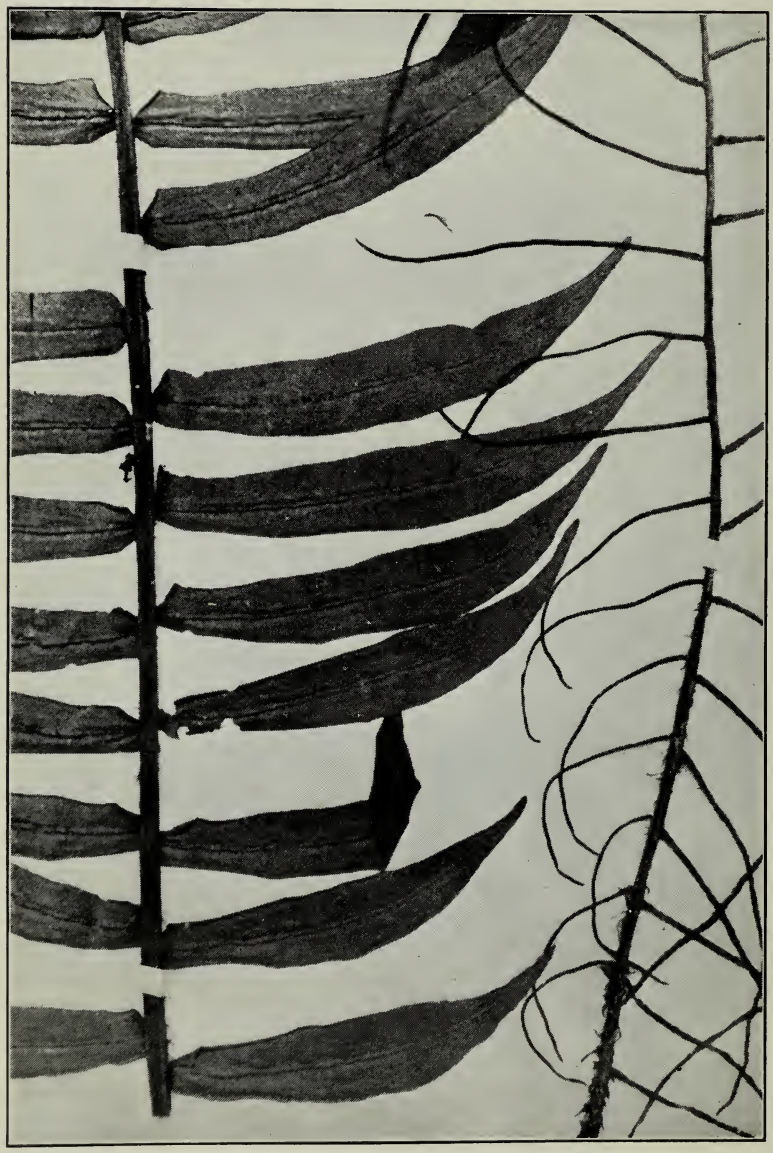
Leptochilus lomarioides Bl. Enum. 206. 1828.

Chilolepton Blumeanum Fée, Hist. Acrost. 89, t. 51. 1845.

Acrostichum Blumeanum Hk. Spec. Fil. **5:** 268. 1864. p.p.



Lomagramma grosseserrata, Type; sterile acrophyll. 3/4 nat. size.



Lomagramma lomarioides, specimen from Blume's herbarium, showing sterile and fertile acrophylls. 2/3 nat. size.

Lomagramma abscondita v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI: 16. 1913. *Ibid.* III ser. **2:** 159. 1920.

This species was described by Blume as follows:

"L. frondibus pinnatis, pinnis sterilibus lineari-lanceolatis, fertilibus angusto-linearibus elongatis stipite rachique paleaceis".

By the courtesy of the Director of the Rijksherbarium at Leiden, I have been able to examine Blume's specimens of this species. There are four sheets, one bearing the name in Blume's hand, the other three all clearly from one collection (perhaps the same collection as the type), and one of them labelled "Herb. Dr. Bl." Judging from the fact that Blume described the fertile pinnæ, which are not represented on the sheet actually bearing his writing, it seems probable that all four sheets were actually seen by him. In any case, they are quite certainly all of the same species, and they agree closely with the type *L. abscondita* v.A.v.R. and a number of other specimens from Java at Buitenzorg. I can therefore with confidence give a full description of the species, except that there are only three specimens which could be regarded as bathyphylls.

Bathyphylls. (description based on three collections from Tjibodas: Fleischer 276, Burck s.n., Palmer & Bryant 1190). Stipes to 15 cm. long, frond to 40 cm. long by 9 cm. wide; pinnæ to 25-jugate, the terminal ones articulate but smallest, with very narrow base. Middle pinnæ to about 5 cm. long and 1.0 cm. wide, the upper base broadly cuneate to subtruncate, the lower base narrowly rounded, edges quite entire, often slightly sinuate especially towards the apex, the apex falcate, acuminate. Texture firm, veins hardly visible on the upper surface, slightly prominent below, the areolæ rather small, usually in 2 rows. Palmer and Bryant's specimen from Salak represents a much younger stage, stipes 22 cm., frond 21 cm. pinnæ 16 pairs.

Sterile acrophylls. Young stipes and fronds very scaly, the scales thin and rather pale, mostly falling as the frond developes. Stipes to 20 cm. frond to 1 m. long and 20 cm. wide, the upper and lower pinnæ gradually reduced, the lowest only 5 cm. long, and more distant. Largest pinnæ to about 12.5 cm. long and 1.5 cm. wide, the upper base broadly cuneate to truncate, the lower base narrowly rounded, occasionally the upper base or both subauriculate. Pinnæ usually widest about the middle, apex gradually acuminate, falcate, the edges entire or undulate, often inrolled when dry. Texture of old fronds subcoriaceous, veins hardly visible on upper surface, usually somewhat raised below but rather broad. Blume's type has the veins more clearly visible than most of the other specimens; young fronds show the veins much more clearly than old ones.

Fertile fronds. Pinnæ sessile, to at least 18 cm. long, 1–2 mm. wide.

This species appears to be common on the mountains in the west of Java, and there are also specimens from east Java which I believe must also be referred to it, though they are not typical. The characteristic features are the narrow rather coriaceous pinnæ of the sterile acrophylls, the very narrow pinnæ of the fertile fronds, and the numerous narrow entire pinnæ of the bathyphylls. The sterile acrophylls are perhaps nearest to *L. Brooksii*, but *L. lomarioides* differs markedly from that species in the narrow fertile pinnæ and the narrow pinnæ of the bathyphylls.

TYPE: Java, Salak, Blume (Leiden).

Other specimens. Res. Preanger: G. Malang, Raciborski s.n. (B, M); G. Rasamala, Raciborski s.n. (B), Hallier s.n. (M); Tjibodas, Arsin 19624 (B), Burck s.n. (B), Bruggeman 438 (B), Palmer & Bryant 1190 (W), 212 (W), M. Fleischer 276 (M); Tjitibo, Tjidadap, Tjibeber, 1000 m., Bakuizen 2402 (B); Tjadas Malang, z.v. Tjibeber, 1000 m., Winckel 1699 (B); Mt. Salak 1000 m., Palmer & Bryant 550 (W), 557 (W); 700 m., 700 (W). *Res. Besoeki:* G. Idjen 1000 m., Posthumus 3774 (B); Weg *v.* Lidjen halfweg Kawah Idjen, 1025 m., Posthumus 378 (Pas); Mont. Tengger 1200 m., M. Buysman 108 (W).

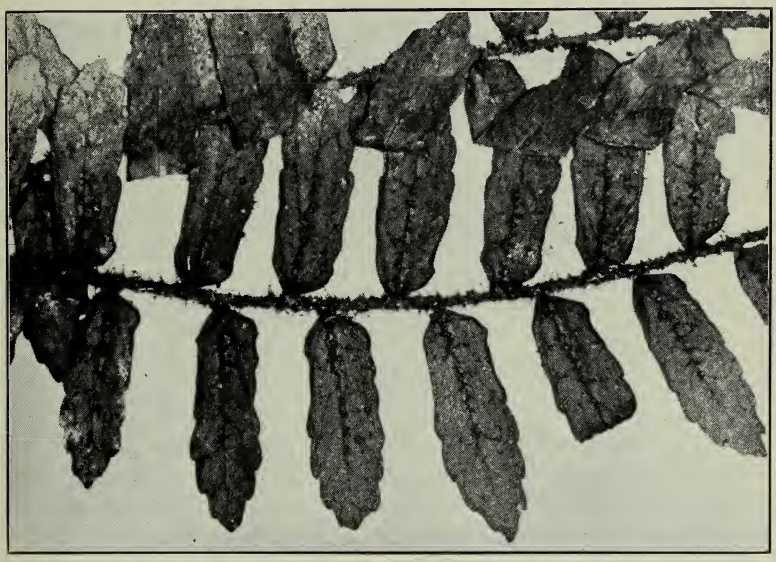
Lomagramma Matthewii (Ching) Holttum comb. nov.

Campium Matthewii Ching, Bull. Fan. Mem. Inst. Biol. **1:** 158, fig. 3, 1930.

This species was based on a collection of large bathyphylls made by Dr. C. G. Matthew in Kwangtung. It was subsequently identified by Mr. Ching (Lingnan Sci Journ. **12:** 566. 1933) with *Aspidium sorbifolium* Willd. This identification however appears very doubtful, as explained under *Lomagramma sorbifolia* at the end of this paper.

I have seen Matthew's specimen in the Hong Kong herbarium, and judging from this and Mr. Ching's description I think it probable that certain specimens of bathyphylls from Assam are to be referred to this species. Also from Assam, and from Tonkin, are specimens of sterile acrophylls which are certainly not *L. grosseserrata* and perhaps belong to *L. Matthewii*. The only fertile frond which might be associated here is on the same sheet as one of the bathyphylls from Assam.

It is clear from the original collection of bathyphylls that *L. Matthewii* is closely related to *L. grosseserrata*, and in the absence of the quite distinct sterile acrophylls above mentioned, I should be inclined to include it with that species; these acrophylls show however that another species is present, but whether that species is *L. Matthewii* is another matter. The present collections are in fact inadequate for more than a tentative account of the species in the region between Assam and southern China to be given. I here quote the original description of *Campium Matthewii*, and add some notes about the other specimens which I think may belong to the species. It is just



Above: *Lomagramma pteroides,* a bathyphyll.
Below: *L. lomarioides,* a bathyphyll. Both x 1.5.

possible after all that the type of *Campium Matthewii* may represent bathyphylls of *L. grosseserrata.*

Campium Matthewii. Rhizome wide-creeping, naked, fleshy, light stramineous, terete, 5 mm. in diam.; stipes remote, pale green, 12–17 cm. long, terete below, deeply bisulcate throughout the rachis above, moderately paleaceous throughout the rachis, paleæ small, brown, membranaceous, lanceolate, acuminate; frond 35–50 cm. long, 10–13 cm. broad, linear oblong, slightly narrowed at base with the apex of rachis often lengthening out into a stout naked prolongation with proliferous tip, pinnate, pinnæ close, 20–27 on each side under the impari-terminal one, 7 cm. long, 1–1.5 cm. broad, gradually decrescent upwards, the uppermost ones 4 cm. or less long. sessile throughout, broadly linear-lanceolate, broadened downward, truncate or cuneato-truncate, acute, margin shallowly crenate above the base, texture thin papery, glabrous except the midrib which is sparsely scaly; venation distinct, main veins wanting, veinlets pauci-anastomosing in 2–3 rows of oblique irregular rhombic areolæ, of which the costal ones much the largest, extending to the half breadth of the pinnæ, all without included veinlets, the marginal areolæ mostly close, very rarely with excurrent free veinlets; fertile fronds not seen.

Distribution: Kwangtung: Lienchow, Dr. Matthew, No. 5108, Dec. 1907.

There is one curious point in the above description, namely "apex of rachis often lengthening out into a stout naked prolongation with proliferous tip". This I have not seen in any specimen of Lomagramma. The apex of the specimen of the type collection of *L. Matthewii* in the Hong Kong herbarium is missing, so that I am unable to verify the matter.

Bathyphylls of other collections. The following agree very well with Matthew's specimen, chiefly differing in the fact that the costal areoles are not so very much larger than the others.

ASSAM. Wallich, s.n. (C, from T. Moore's Fern Herbarium). Chima Forest, Garo Hills, 300 ft., Dec. 1890, Gustav Mann (W).

Sterile acrophylls. I have seen one good collection from Manipur (Meebold 6233, in Calcutta herbarium). This has pinnæ very like those of *L. sumatrana,* differing chiefly in the very broadly cuneate bases of the middle pinnæ. The pinnæ are up to about 12 cm. long and 2 cm. wide, margins entire except towards apex where they are rather sharply toothed.

There is another collection from Tonkin (Province de Hoa Binh, vers 500 m., Avril 1926, U.S. Nat. Herb.) with rather stout climbing rhizome, but the frond a rather intermediate one, having apex continuous with the rachis as in typical bathyphylls. It is in fact rather intermediate in character between the bathyphylls and acrophylls from Assam and Manipur above mentioned, and forms the strongest link connecting these specimens together.

Fertile fronds. Mann's specimen from Garo Hills, Assam, above cited, has part of a fertile frond, attached to a typical stout climbing rhizome, along with a large bathyphyll. The

fertile frond has a stipe 28 cm. long, and pinnæ to 16 cm. long and 8 mm. wide, on stalks 3 mm. long.

I am reasonably certain that the specimens above described from Assam, Manipur and Tonkin are one species, but I do not feel so sure that they are *L. Matthewii.* They are also rather near *L. sumatrana.* There the matter must be left until fresh collections are made.

Lomagramma melanolepis v.A.v.R. Bull. Jard. bot. Buitenz. ser. III, **5:** 212. 1922.

L. pteroideæ J. Sm. affinis.—Squamæ rhizomatis, stipitum, rhachidum costarumque sparsæ, nigræ vel obscure castaneæ. Frondes steriles c. 60 cm. longæ; rachis apicem versus anguste alata; ala ad basin pinnarum superiorum brevius vel longius dentiformi-auriculata. Pinnæ flaccidæ firmiter herbaceæ, subapproximatæ, sessiles, patentes, in sicco olivaceæ, supramedianæ maximæ, lineares, 12–13 cm. longæ, 1.75–2 cm. latæ, integerrimæ vel apice acuminato, recto vel subfalcato remote subserrulato-crenulatæ, basi obliquæ et plus minusve inæquilateræ, rotundatæ vel late rotundato-cuneatæ; venæ distinctæ, pallidæ (colore pinnarum). Frondes fertiles minores, usque as 40 cm. longæ, pinnis remotis, horizontalibus, contractis. Sori capsulis juvenilibus paraphysis longe stipitatis, peltatis copiose intermixtis.

Fertile frond of the specimen on hand still young, with the pinnæ 5 cm. long, 3 mm. broad.

TERNATE: Foramadjahi, in forest, 700 m. Beguin 1114 (B).

I have examined the type of this species. Like *L. sinuata,* it has narrow black scales on the rhizome and on the very young unexpanded fronds. Through an ordinary hand lens these scales appear black with irregular narrow paler margins. Through a microscope, the central cells are seen to have very thick black lateral walls, and the lumen is a brownish colour. The marginal cells have thin walls and some of them are elongated to give an irregularly fringed condition. The small scales on the frond are few; they are rather dark, but of typical bullate form and the cells normal.

The sterile pinnæ are hardly toothed, in which they agree with *L. sinuata;* but they are much smaller than the pinnæ of that species, and are sessile, lacking the peculiar basal characters. The fertile pinnæ are up to 4 mm. wide (not 3 mm. as stated in the description above quoted). They seem to be practically mature and are almost sessile.

The distinctive characters therefore are the rhizome scales, the medium sized almost entire sessile sterile pinnæ and the subsessile short and relatively broad fertile pinnæ.

At Ternate, this species falls within the range of distribution of *L. sinuata* and is presumably a local derivative. Further collections may possibly show it to have a range of variation bridging the gap with *L. sinuata.*

Lomagramma Merrillii Holttum sp. nov. **Plate 14.**

Bathyphyllorum lamina 16 cm. longa, 4 cm. lata, pinnæ c. 10-jugatæ; pinnæ laterales maximæ, 3.5 cm. longæ, 1.2 cm.

Lomagramma Merrillii, Type. The fertile frond is incompletely expanded. Twice nat. size.

Lomagramma novoguineensis (Docters van Leeuwen 9616), showing the upper surface of the broad blunt fertile pinnæ. Twice nat. size.

latæ, basi supra late infra anguste cuneatæ, margine acute serratæ, apice acutæ; pinna apicalis 6 cm. longa, 1.4 cm. lata, acuminata; textura tenuis, venulæ infra elevatæ, supra haud elevatæ.

Acrophyllorum sterilium stipites ad 15 cm. longi, lamina ad 45 cm. longa et 15 cm. lata; pinnæ superiores maximæ, inferiores sensim reductæ, infimæ c. 4 cm. longæ, stipitatæ 3 mm.; pinnae maximæ 9 cm. longæ, 1.7 cm. latæ, basi superne late inferne anguste cuneatæ, apice acutæ, falcatæ, margine apicem versus irregulariter dense sæpe obtuse serratæ, (margines pallidæ cartilagineæ), textura subcoriaceæ, venulis inconspicuis areolas parvas formantes præditæ. *Pinnæ fertiles* stipitatæ 5 mm., ad 9 cm. longæ, 3 mm. latæ.

TYPE: Mindanao, Dist. Zamboanga, Merrill 8282 (M), "very damp shaded ravine, on trees climbing, at 400 m.".

Other specimens. Mindanao, Camp Keithley, Lake Lanao, M. S. Clemens s.n. May 1907, Sept.–Oct. 1907 (3 sheets, M).

Merrill's specimen is the only one showing bathyphylls, for which reason I take it as the type. His sterile acrophyll is thinner in texture and more toothed than those of Mrs. Clemens; *i.e.* it is nearer to the bathyphyll condition. I believe however that all represent the same species. It is a rather small species, and is characterised by the combination of characters: small narrow bathyphylls with large articulated apical pinnæ, subcoriaceous pinnæ of sterile acrophylls, fertile pinnæ with stalks 5 mm., the pinnæ of moderate length. A character which seems to be almost general is that the stipes and rachis are usually reddish when dry; some are however stramineous.

The species has so far only been found in the island of Mindanao. It is very different from the two other species occurring in that island, *L. pteroides* and *L. Copelandii.*

Lomagramma novoguineensis (Brause) C. Chr. Index Suppl. III, 124, 1934. **Plate 15.**

Leptochilus novoguineensis Brause, Engl. Jahrb. **56:** 117. 1920.

Rhizoma scandens, validum, 5–7 mm. crassum, radices numerosas 1.5–3 cm. longas, fusco-pilosas gerens paleisque fuscis, sublinearibus, acuminatis margine subintegris, ca. 7 mm. longis 0.7 mm. latis, dense instructum, folia dimorpha interstitiis ca. 20 cm. longis emittens. Foliorum sterilium petioli 7–9 cm. longi, 4–5 mm. crassi, supra sulcati infra teretes, untrinque paleis iis rhizomatis subæqualibus densissimis muniti; lamina coriacea, ca 62 cm. longa, 22 cm. lata, supra glabra infra paleolis bulbosis prædita, ambitu oblonga, basi vix angustata, ad apicem versus e media laminæ parte decrescens pinnaque terminali sublineari, ca 3.5 cm. longa 2–3 mm. lata, basi leviter incisa desinens; pinnis articulatis, subsessilibus, e basi paulo angustata, subrotundo-truncata lineari-lanceolatis acuminatis, ad apicem versus levissime serratis, cetera in parte subintegris, 1–2.4 cm. inter se (costis) distantibus, alternis vel suboppositis, superioribus patentibus, intermediis inferioribusque horizontalibus, infimis 1–2-jugis interdum paulo

abbreviatis et deflexis, maximis (intermediis) 11 cm. longis, 1.3 cm. latis; rachibus petiolis similibus paleatis; costis utrinque paleis similibus sed minoribus supra sparsis infra densis armatis; nervis inconpiscuis areolas obliquas formantibus, nervis apice liberis nullis. Folia fertilia differunt petiolis paulo longioribus, ca. 12.5 cm. longis, pinnis e basi truncata, non angustata linearibus abrupte in apicem obtusiusculum desinentibus, margine subintegris, subpetiolulatis, maximis 4.5 cm. longis, 0.8 cm. latis. Sori totam inferiorem pinnarum partem occupantes.

TYPE: N. E. New Guinea, Kaiserin-Augusta (Sepik) River, Etappenberg, 850 m., Ledermann 9524.

I have not seen the type, but have examined another specimen from New Guinea: Mamberamo bij Albatros Bivak, 50 m., Docters van Leeuwen 9616 (Expeditie Nieuw Guinea 1926), in Herb. Buitenzorg. The striking feature of this specimen is the fertile pinnæ which are about 4.5 by 0.6 cm., with short stalks and blunt apices, as described by Brause. The sterile pinnæ are all somewhat damaged, and are rather smaller than described (to 9.5 cm. long), but I have little doubt that this is Brause's species.

Lomagramma perakensis Bedd. Handb. Suppl. 107. 1892. **Plate 16.**

Beddome's description is as follows:—

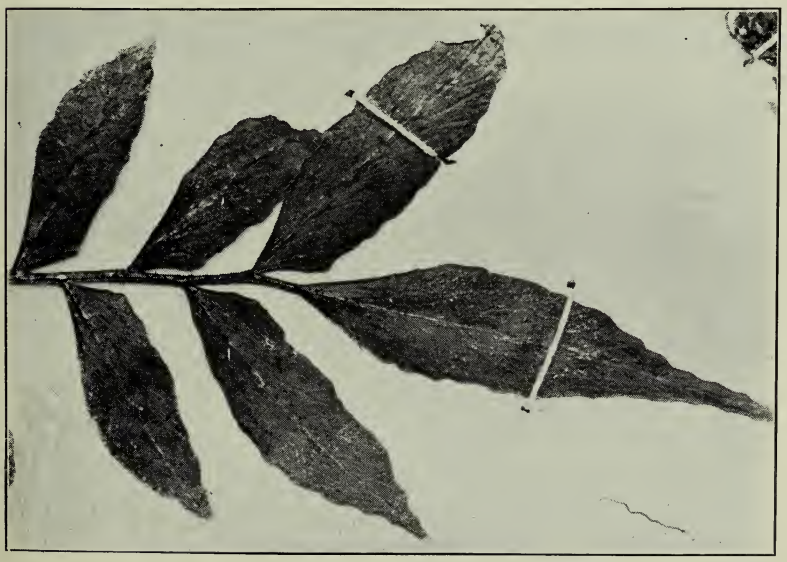
Rhizome 40–50 feet long, 1 in. diameter, epiphytic on trees; stipes 6–8 inches apart, about 1 foot long, slightly scaly, but scales soon deciduous, rachis not winged upwards; frond 3–4 feet long, very similar to those of Blumeana, but coriaceo-herbaceous in texture, pinnæ entire or obscurely crenated, quite glabrous or costa very slightly scaly, veins sunk and scarcely visible, venation very similar to Blumeana but closer and costal areoles smaller; fertile pinnæ 1–1½ lines broad.

Perak, 400 ft. alt. (Day). Referred by me to Blumeana in my list of Day's Perak ferns. Perak, 2,500–3,000 feet alt. (Dr. King's collectors, No. 8345), the pinnæ all fall off in drying, much more so than in Blumeana.

In Beddome's list of Day's collections (J. Bot. 1888, p. 2), the altitude is given as 4,000 ft.; the 400 ft. of the Handbook is doubtless an error. I have not been able to find Day's specimen, and it seems rather doubtful whether the specimen exists. It would therefore be best to take Kunstler's collection as the type of the species; specimens were distributed to several herbaria.

Th following description is based on the specimens in the Singapore herbarium.

Bathyphylls. Largest fronds commonly about 30 cm. long and 12–15 cm. wide, the stipe to about 25 cm.; pinnæ about 10–15 pairs, or even less, the apical pinna articulate and similar to the others; lower pinnæ largest in larger fronds, apical pinnæ largest in fronds of very young plants; rachis winged almost throughout. Pinnæ distinctly oblique or the lower ones sometimes horizontal, sessile; middle pinnæ with upper base cuneate



Above.: apex of bathyphyll of *L. sumatrana* (the rachis continuous). Below: apex of bathyphyll of *L. perakensis,* from a young plant (apical pinna articulate). Both x 1.5.

about 45° to the midrib, lower base very narrow; edges entire, usually somewhat undulate, not toothed; apex subacuminate; midrib often somewhat falcate; texture thin but firm; veins slightly prominent above and below, often not distinct.

Plants with fronds only 4 cm. long have the apical pinna (15 by 4 mm.) articulate, the veins free or forming an incomplete series of areoles. Smaller fronds sometimes have an equally forked not articulate lamina at the apex.

Sterile acrophylls. Stipes to 40 cm. long; fronds to about 1.25 m. long. Rhizome to at least 1.5 cm. in diameter, densely scaly towards apex; stipes to 1 cm. thick at base, roughened from bases of scales. Pinnæ oblique, gradually smaller towards apex. Largest pinnæ 26 cm. long, 2.5 cm. wide, base rather narrowly unequally cuneate (upper base as much as 45° to midrib, lower always very narrow), edges slightly undulate, not toothed, more or less reflexed when dry, apex acuminate; midrib often slightly falcate towards apex. Texture of fully matured fronds subcoriaceous; colour olive green, often rather pale; veins usually more prominent on lower surface, but often almost immersed in the substance of the frond, rarely very sharply defined on the surface, usually in three series of areoles, the costal ones often smaller than the next series.

Fertile pinnæ to 40 cm. long (commonly 15–20 cm.) and 3–5 mm. wide when dry, on stalks 3 to 7 mm. long; midrib with two dorsal and three ventral vascular bundles (one in small pinnæ); venation in two or three rows of small areoles. The Pulau Tioman specimen has pinnæ only 12 cm. long; its sterile pinnæ are small also (13 cm. long, 2 cm. wide).

MALAY PENINSULA (all in H. S.). Sungei Ujong: Hullett s.n. Aug. 1880. Penang: Curtis 618. Pahang: Cameron Highlands 4,500 ft., Holttum s.n. 31.3.30; Robinson's Falls, 4,600 ft., S.F.N. 24994, 23259 (Holttum); Sungei Terla, 3,900 ft., S.F.N. 31329 (Holttum); Fraser's Hill, 3,600 ft., Holttum s.n. 18-9-23, 4,000 ft., Holttum s.n. 21-3-29; Bukit Kajang, Pulau Tioman, 2,000 ft., S.F.N. 18945 (Henderson). Ferak: Taiping, 2,500–3,000 ft., King's collector 8345.

SUMATRA. G. Kœrintji, 1600 m., Bunnemeijer 8711 (B, two sheets, fertile only).

Bunnemeijer's specimens have long pinnæ, agreeing with *L. perakensis,* but in the absence of sterile fronds there is some doubt of the identity. They cannot be either *L. sumatrana* nor *L. abscondita;* if not *L. perakensis,* they represent a new species.

This very fine species appears to be quite distinctive in its bathyphylls; in its acrophylls it is nearest to *L. Brooksii* and *L. lomarioides,* which are mountain plants of Borneo and Java respectively.

Lomagramma polyphylla Brack. Cryptogamia, Filices, in Wilkes, U.S. Expl. Exped. **XVI:** 83, t. 12. 1854.

L. rhizomate scandente; stipitibus sulcatis furfuraceo-squamosis; frondibus bipinnatis; pinnis petiolatis alternis; rhachi marginata paleaceo-hirsuta; pinnulis glabris approximatis subalternis sessilibus oblongo-lanceolatis crenatis; costis sparsim paleaceis.

Hab. Ovolau, Feejee Islands: on trunks of trees.

Stipes thick and of a pale straw colour, about 8 inches long, with a few brown *furfuraceous scales,* which extend to the rhachis. Sterile *fronds bipinnate,* large, 2 to 3 feet long. *Pinnules* numerous, *approximate, glabrous, subalternate, sessile,* about 1 inch long and 3 to 4 lines broad, *oblong-lanceolate,* the margin irregularly *crenate.* Rhachis of the pinnæ with two broad marginal lines in front (a character not well represented in the figure), beset with slender fugacious paleæ. Fertile fronds wanting.

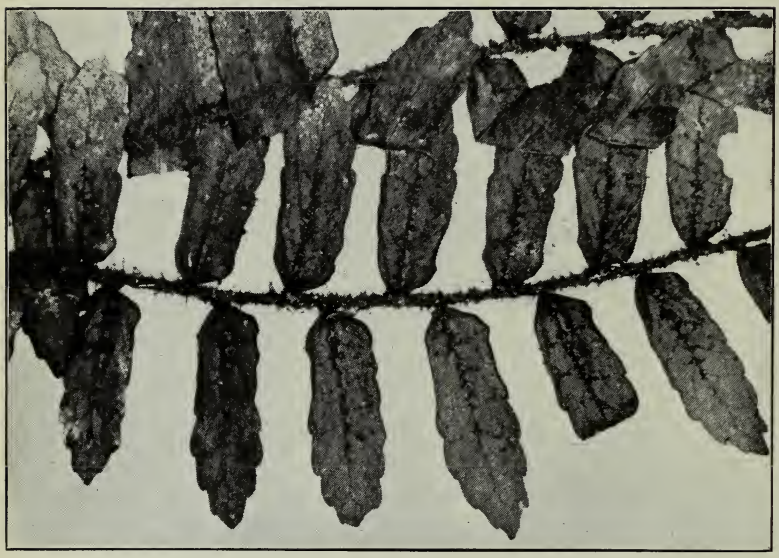
In the absence of the fertile fronds we infer from the habit of the sterile ones, with their articulated pinnæ and uniform reticulated venation, that our plant belongs to the present genus.

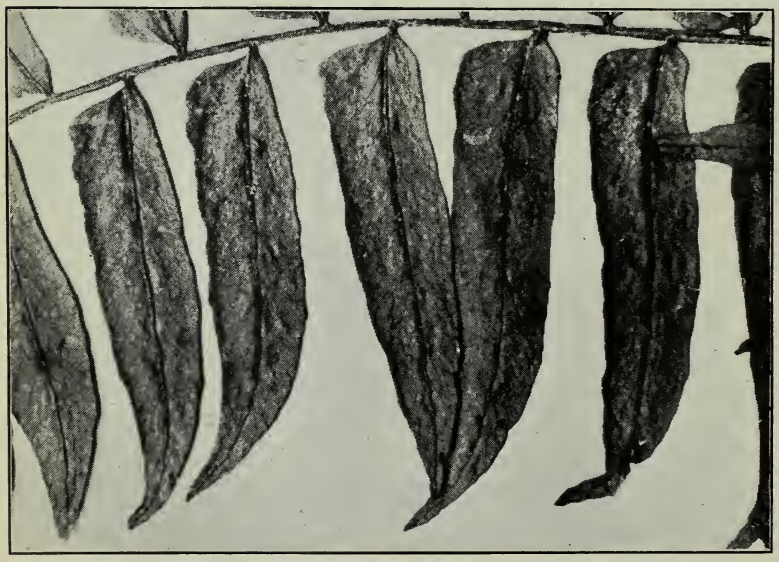
I have seen the type specimen in the U.S. National Herbarium. It has 9 pairs of pinnæ, oblique, all articulated; the middle pinnæ largest, about 20 cm. long and 5 cm. wide; pinnules all articulate about 20 pairs, slightly oblique, about 1 cm. apart, the largest about 2.7 cm. long and 0.7 cm. wide, the base not quite equally cuneate, the apex gradually tapering and slightly falcate, colour rather pale, veins distinct, pale, in two series of rather narrow oblique areoles, about 9 areoles in the costal series.

At the British Museum and Kew there are several other collections of bipinnate fronds from Fiji and the New Hebrides (Aneiteum); in the U.S. National Herbarium are also specimens from Eua Island, Tonga. Both the Aneiteum and Tonga specimens differ rather strikingly from the type of *L. polyphylla* and possibly represent distinct bipinnate species. The other specimens from Fiji however show in some cases intermediate characters. I think therefore that we must wait for further information before attempting to describe any new bipinnate species. Probably the matter will not be settled until someone makes careful field observations on these plants in the various island groups concerned.

The characteristic feature of the Aneiteum specimens is the very short pinnules (to about 1.4 cm. long), with few rather large marginal teeth and areoles to correspond. The specimen from Eua Island, Tonga, has pinnules slightly larger than those of the type of *L. polyphylla,* the margins broadly and slightly lobed, the costal series of areoles about 6 in number, to correspond with the lobes.

Bathyphylls are present in one of the Fiji specimens at the British Museum (Harvey), in one collection from Aneiteum and in the Tonga collection. In all cases they are simply pinnate, the pinnæ larger than the pinnules of the acrophylls, with shallowly lobed margins. One collection from Fiji (Meebold





Above: *Lomagramma pteroides,* a bathyphyll.
Below: *L. lomarioides,* a bathyphyll. Both x 1.5.

16885, B.M.) is a small bipinnate frond with rather large pinnules (to 4.8 cm. long and 1.5 cm. wide); this is perhaps a stage intermediate between typical bathyphylls and acrophylls, but it might possibly represent a distinct species.

Fertile fronds are present in one collection from Aneiteum (McGillivray, Kew) and in the Tonga collection. Both are very similar, the fronds bipinnate, of much the same size as the sterile ones, the pinnules reduced in size, to about 10 mm. long by 3 mm. wide. The spores are characteristic of the genus.

The following list includes all the bipinnate specimens I have seen.

FIJI. U.S. South Pacific Exploring Expedition 1838–42 (2 sheets, W, type collection). Seeman 713 (2 sheets, B.M.), 421 (B.M.). W. H. Harvey (2 sheets, B.M.). Nine miles above Suva, Meebold 16885 (B.M.). Korumbamba Hill, near Suva, Meebold 16831 (B.M.).

NEW HEBRIDES. Aneiteum, McGillivray 44, "woods, climbing trees" (Kew). Moore 1890, no. 17 (B.M.).

TONGA IS. Eua Island, H. E. Parks 16311 (W, 3 sheets). "Johannsen's plantation, climbing tall trees, alt. 150 m. Fruiting branches in top of tallest trees only. Vines many feet long".

Lomagramma pteroides J. Sm. Journ. Bot. **3:** 402. 1841. *ibid.* **4:** 152. 1841. Hook. Gen. Fil. t. 98. **Plate 13.**

Lomagramma subcoriacea Copel. Phil. Journ. Sci **40:** 308. 1929.

L. pteroides var. *subcoriacea* Copel. ibid. **3C:** 32. 1908.

The type of this species is Cuming 223, from Luzon. I have examined the specimens of this collection at Kew and the British Museum, and I can see no distinction from Copeland's species, of which I have seen the specimens of the type collection in the herbaria of Manila and Buitenzorg and also several specimens later distributed by Copeland. Copeland's specimens have rather narrower firmer pinnæ, drying reddish; but the essential characters of the broad base of the sterile pinnæ and the stalked fertile pinnæ with part of the lamina sterile towards the base are the same in both. The reddening of the fronds on drying is rather variable, and is perhaps to some extent connected with the method of drying and perhaps with the position of the plant and age of the fronds at the time of gathering.

The following description is based on all the specimens at my disposal. The description of the bathyphylls, which are quite distinctive, is taken from Merrill 780 (Paragua) and Copeland 1736 (Mindanao). These are perhaps not of a fully mature size.

Bathyphylls. Stipes short (longest seen 4 cm.). Largest frond seen about 28 cm. long by 4.5 cm. wide. Pinnæ to about

28-jugate, gradually reduced from the middle of the frond to the base, the lowest very small (7 mm. by 3 mm.) but not much more distant, the upper pinnæ gradually reduced towards the apex, which is continuous with the rachis and narrow, unlike the other pinnæ. Largest pinnæ about 2.5 cm. long and 0.7 cm. wide, the base unequal, the upper side broadly, the lower narrowly cuneate, the edges crenulate (teeth 2–3 mm. apart), the apex acute to somewhat blunt; bases and apices of lower pinnæ more rounded. Stipe, rachis and costæ rather densely scaly; scales rather dark. Pinnæ reddish when dry; veins strongly raised on both surfaces, in one or two series of areoles.

Sterile acrophylls. Rhizome with up to 5 leaf-gaps in transverse section, very stout in well-grown plants. Stipes usually 20–30 cm. long. Largest pinnæ seen 22 cm. long, 2.2 cm. wide; pinnæ commonly about 12–15 cm. long and 1.2 to 1.8 cm. wide, the base slightly unequally subtruncate to subcordate, the lower base narrower and more rounded to cordate, the sides subentire parallel, the apex acuminate, somewhat falcate, irregularly undulate or bluntly toothed; the uppermost pinnæ gradually smaller, often less truncate at the base, the apex more clearly toothed; lowest pinnæ (except on very small fronds) not much reduced, the base often equally cordate and distinctly stalked. Texture thin; colour often reddish; veins raised slightly on both surfaces, usually more or less brown on lower surface, the areoles rather small, in 2–3 series. Scales rather numerous, dark.

McGregor 235 from Negros shows an interesting transition from bathyphyll to acrophyll. The Washington specimen has the apex continuous with the rachis, the Manila specimen has the apical pinna articulate; in each case a fertile frond is attached to the same rhizome as the sterile.

Fertile fronds. Pinnæ to 27 cm. long, commonly about 20 cm., base unequally cuneate, widening rather suddenly from a winged stalk up to 1 cm. long; base of pinna 7–10 mm. wide, only the edge fertile, the upper part gradually narrowed, the distal half sometimes entirely covered with sporangia, but often with a narrow sterile lamina on either side of the midrib to the apex.

TYPE. LUZON, Cuming 223.

Other specimens. LUZON: Lucban, Tayabas, Elmer 9068, fert. (W, B). PARAGUA: E-wi-ig River, Merrill 780, bath. (W, M). NEGROS: Dumaguete (Cuernos Mts.), Prov. Negros Oriental, Elmer 10175, fert. (B, M, W). PANAY: Mt. Bulilao, Capiz Prov., Bur. Sci. no. 35754 (Martelino & Edano, S, M). MINDORO: Baco River, McGregor 235, fert. (W, M); Alag River, Merrill 5654, fert. (M); Mt. Halcon, Bur. Sci. no. 40657, fert. (Ramos & Edano, M). MINDANAO: Camiguin de Mindanao, Bur. Sci. no. 14764, fert. (Ramos, M); Cotabato, Distr.

of Zamboanga, Copeland 1736, fert. & bath. (W, M). SULU ARCH: Jolo, Clemens 9371, fert. (M).

This species has only so far been found in the Philippines, but within those islands it is widely distributed. It is very clearly characterised by the fertile pinnæ, which are the only ones having regularly a partial sterile lamina that I have seen in the genus. The bases of the sterile pinnæ are also distinctive but this character varies from base to apex of the frond and needs careful observation. There is much variation in the width of the pinnæ of the sterile acrophylls; and in the development of the reddish colour.

Lomagramma sinuata C. Chr. Svensk Bot. Tidskr. **16:** 98, f. 5. 1922.

Rhizomate ad caudices arborum late repente, lignoso, longissimo, 1.5–2 cm. crasso, inferne radicibus brevibus dense radicante, superne 5-sulcis, rimis acutis separatis, profunde sulcato, squamis minutis anguste lanceolatis adpressis atrofuscis sparse obtecto, denique dunudato. Foliis difformibus ex schedula pendentibus, valde remotis. Stipitibus foliorum sterilium cum rhizomate continuis ad 25 cm. longis, basi 6 mm. crassis, cinnamomeis, glaberrimis, superne auguste profundeque sulcatis. Lamina sterilis ovato-lanceolata, verisimiliter 1 m. vel ultra longa herbacea, siccitate brunnea, glaberrima; rachi non alata. Pinnis 10–15-jugis, usque ad 6 cm. inter se remotis alternis, erecto-patentibus (nec falcatis), petiolis 1 cm. longis stipitatis ad rachin articulatis, facile deciduis, e basi postice cuneata actice rotundato-truncata in petiolum decurrente oblongis, breviter acuminatis, 20 cm. longis 4 cm. latis, sinuato-repandis, margine ipso integerrimis, pinna terminale conformi. Venis distinctis reticulatis inferne elevatis, areolas 4–5 inter costam et marginem formantibus, areolis elongatis plerumque 5-angulatis, costalibus valde inæqualibus.—*Foliis fertilibus* minoribus, lamina ad 35 cm. longa, pinnis configuratione sterilibus similibus, 10 cm. longis, 8 mm. latis; stipite rachique paleis minutis lanceolatis adpressis centro atris marginibus basique lutescentibus onustis; sporangiis breviter pedicellatis paginam inferiorem excepto spatio mediano 1 mm. lato sparse paleaceo (paleis adpressis e basi peltata suborbicularibus in apicem longum acuminatum contractis) occupantibus; marginibus ipsis soris destitutis.

Bolaang-Mongondou, Modajag, North Celebes, 750 m., on stems of living trees, leaves pendent, fertile ones rare. W. Kaudern, no. 73 (B).

The characteristic features of full-sized acrophylls of this species are the long, very broad, thin, almost entire sterile pinnæ with their long narrowly winged stalks and the broad fertile pinnæ, also stalked; the venation of the sterile pinnæ is in several series of areoles, those towards the margins being very small. The scales on rhizomes and very young fronds resemble those of *L. melanolepis*.

I have seen a pinna of the type. I have also seen an entire fertile frond of another collection from Celebes, which agrees with Christensen's figure and description. These specimens have no bathyphylls.

There are specimens (including a fertile frond) from British North Borneo which appear to me to be referable to this species;

there are also specimens from East Java. From New Guinea (Papua) are specimens of sterile and fertile acrophylls collected by Carr; these agree exactly with Celebes specimens, except that the sterile pinnæ are rather long-acuminate. There is another specimen, from southern Dutch New Guinea (von Romer 216), which has smaller (but still acuminate) sterile pinnæ than the Papuan specimen, and the pinnæ are unstalked; the specimen consists of the apical part of frond, and it is possible that the basal part might have had larger and stalked pinnæ.

Of all these collections, only that of Dr. Posthumus shows bathyphylls, and it is fortunate that there can be no doubt of their authenticity. The collection consists of several fronds, both bathyphylls and sterile acrophylls. The latter are in my opinion typical of *L. sinuata* and Dr. Posthumus writes "the material belongs to one and the same plant". The bathyphylls are very similar to those of the unnamed Java species, and it might be difficult to distinguish them with certainty.

Bathyphylls. Stipes about 4 cm. long, fronds commonly to 22 cm. long and 7 cm. wide; pinnæ about 12-jugate; lowest pinnæ short and somewhat deflexed; apical pinna articulate, the base almost equal and the apex rather acute; middle pinnæ usually largest, commonly about 3.8×1.2 cm., the lower base very narrowly cuneate, the upper subtruncate but suddenly narrowing near the very base and so forming a sigmoid curve, the edges slightly and rather distantly toothed, especially towards apex, the apex rather bluntly rounded, texture thin, venation distinct, of two series of areoles; wing of the rachis rather unusually pronounced with an auricle below each pinna; scales fairly numerous on rachis, a medium brown colour.

The bathyphylls differ from those of the unnamed Java species in the sigmoid curve of the upper base, the less toothed margin, and the blunt apex; also perhaps in the rather large wing to the rachis and paler scales.

The specimens show another feature not mentioned in the original description, namely that the sterile acrophyll pinnæ are not always so long-stalked as described. The smaller acrophylls, and often the upper pinnæ of larger ones, would perhaps hardly be described as stalked, but they all have the sigmoid curve of the upper base described in the bathyphyll, only in a more pronounced degree. In the larger pinnæ this curve is exaggerated, and combined with a similar but much flatter curve in the narrow lower base gives a winged stalk. The lowest pinnæ of large acrophylls are rather short (not much more than half the length of the longest ones), and the lower base much broader, sometimes almost equal to the upper base, the winged stalk still present. In the pinna from the type collection in the Buitenzorg herbarium the winged stalk is only 5 mm. long, and this seems a common length.

Another correction of the original description (so far as complete specimens examined by me are concerned) is that the pinnæ may be up to 22-jugate.

CELEBES. N. Celebes: Kaudern 73 (type, as cited above). S. Celebes: Kosali-Porema, 650 m. Kjellberg 2608 (B).

BORNEO. B. N. Borneo: Menetendok, Kinabalu, 2,500 ft., Clemens s.n. 1-3-33 (S); above Koung, 2,500 ft., Clemens 51308 (M).

JAVA. Res. Pasoeroean, Tangkil Zuidergeberte, 400–500 m. Koorders 23554b (B). Res. Probolinggo, Mt. Lamongan, 450 m., Posthumus 3975 (S).

NEW GUINEA. Papua: Veiya, sea level, Carr 11677 (S). Dutch N. Guinea: von Romer 216 (B).

Lomagramma sumatrana v.A.v.R. Bull. Jard. bot. Buitenz. III. Ser. **2:** 158. 1920. **Plate 16.**

Leptochilus cuneatus R. Bonap. Notes Pterid. **XIV:** 453. 1923.

The original description of this species was as follows:—

L. lomarioideæ J. Sm. affinis sed pinnis sterilibus integerrimis vel ad apicem solum serratis, in sicco viridi-vel fusco-olivaceis, subtus quam supra pallidioribus, pinnis fertilibus anguste linearibus, 4–5 mm. latis subtus unique soriferis basi interdum sterilibus dilatatisque.

Forest; to 5 m. high scandent; alt. 350–500 m.—Originally determined by me as *L. pteroides* J. Sm.

SUMATRA (Deli, Sibolangit, J. A. Lörzing nos. 5564, 5623, 20th March–8 April 1918).

It is evident that by *L. lomarioides* in the above description the author meant the unnamed lowland species of Java, not the true *L. lomarioides* (=*L. abscondita* v.A.v.R.), which has quite entire pinnæ. I have examined the type of *L. sumatrana,* and believe it to be identical with the lowland species of the Malay Peninsula, which is well represented in the Singapore herbarium by bathyphylls as well as acrophylls. The following full description is based on Peninsula specimens so far as bathyphylls are concerned, and on both Sumatran and Peninsula specimens for the acrophylls.

Bathyphylls. Stipes 3–10 cm. long; lamina to about 40 cm. long and 9 cm. wide. Pinnæ 20 to 30 pairs, lowest rather reduced, more distant and reflexed, upper pinnæ gradually smaller, the uppermost grading into lobes on the apex of the frond which is not pinna-like and not articulated to the rachis. Largest pinnæ about 5 cm. long by 1.2 cm. wide, commonly about 4 cm. by 0.9 cm., at right angles to the rachis, upper base broadly subtruncate subauriculate, lower base half as wide, rounded or sometimes nearly cuneate, sides almost parallel for two-thirds of their length, than gradually tapering to acute or subacute apex; edges shallowly crenate with one or two sharper teeth at the distal end of each lobe, the teeth or groups of teeth 3–5 mm.

apart. Texture thin, colour usually green when dry but sometimes brown; midrib pale, raised above and below, veins distinctly prominent on both surfaces when dry, concolorous with the surfaces, slender.

Sterile acrophylls. Stipes to 20 cm. long; frond to at least 90 cm. long and 25 cm. wide. Lowest pinnæ somewhat reduced and more distant, uppermost gradually smaller, apical pinna articulate and same shape as others. Middle pinnæ to about 14 cm. long and 2 cm. wide (occasionally to 2.5 cm.), at right angles to the rachis or slightly oblique, sessile or stalked less than 1 mm., base broadly cuneate above, rounded to cuneate below and about half as wide, edges usually distantly toothed towards apex, otherwise entire, sides approximately parallel for ⅔ of their length, apex acuminate; texture thin but firm, veins raised above and below, in 3 series of areoles, the costal areoles not considerably larger than the next series.

Fertile fronds. Pinnæ 2.5 to 3 cm. apart, to about 15 cm. long by 5 mm. wide, stalked to 2 mm., the base unequal; upper pinnæ gradually reduced to about 4 cm. long; venation in 2 or three series of areoles, usually prominent above; lower surface soriferous throughout except for the midrib and the thin pale edges.

The characteristic features of this species are the long narrow bathyphylls with many pinnæ and the apex not articulate, the broad sterile acrophyll pinnæ, thin in texture and slightly toothed at most towards the apex, and the broad slightly stalked fertile pinnæ.

I have not seen Brooks's specimen from southern Sumatra which was described by Bonaparte as *Leptochilus cuneatus,* but from the description (especially of the broad fertile pinnæ) it appears almost certainly to belong here. Bonaparte quotes also under *Leptochilus cuneatus* a specimen of Raciborski from Java (Salak). It seems possible that this is a paratype of *L. abscondita* (*L. lomraioides*) but if so the description would not apply to it. I have seen no specimens from Java to which the description of *L. cuneatus* would apply.

In his description, v.A.v.R. has the phrase "basi interdum sterilibus dilatatisque", referring to fertile pinnæ. The type collection has a frond which is partly fertile and partly sterile, and at the transition region some pinna are sterile at the base with fertile apical half. This is of course not a character of the species, but just a chance occurrence.

L. sumatrana occurs in the low country and foothills of the Main Range in the Peninsula, and, so far as recorded, in low country also in Sumatra. The mountain species is *L. perakensis,* which is very different at all stages.

SUMATRA. Sibolangit, 475 m., Lörzing 5564 (B, S, M), 5623 (B). Benkœlen, Lebong Tandai, Brooks 4678 (type of *Leptochilus cuneatus* R. Bonap., not seen).

MALAY PENINSULA (all S). Selangor: Ginting Simpah, 1,500 ft., S.F.N. 26104 (Holttum). Negri Sembilan: Ulu Bendul, S.F.N. 9859 (Holttum). Pahang: Pulau Tioman, W. of Joara Bay, S.F.N. 1138 (Burkill). Perak: Chanderiang, 500–1,000 ft., King's Collector 5778 (distributed as *Acrostichum perakense* Bedd.).

Lomagramma sp.

As noted by van Alderwerelt van Rosenburgh, there are two species of Lomagramma in Java (in addition to *L. sinuata,* which has been twice collected in East Java); van Alderwerelt accordingly decided to provide a name for the second species. Owing to the fact that he evidently never saw the type of *L. lomarioides,* he gave a new name to that species instead of the other, which therefore still lacks a name. The unnamed species is evidently a fairly common one in some parts of Java, but curiously enough it has never been collected in a fertile condition. It is very similar to *L. Copelandii,* and might possibly be identical with that species. In view of this uncertainty, I do not name it here, but give a description of the bathyphylls and sterile acrophylls. The bathyphylls are rather similar to those of *L. sinuata,* but the pinnæ are much more toothed, more inclined to have an acute apex, and the scales are more numerous and darker. The acrophylls lack the characteristic base of *L. sinuata* and are distinctly toothed towards the apex.

Bathyphylls. Smallest fronds seen, with lamina 12 cm. long, have the apical pinna largest and articulated like the others. This condition persists in bathyphylls up to 25 cm. long; in larger fronds the largest pinnæ are about one-third from the apex, the apical pinnæ somewhat reduced. Middle pinnæ of typical fronds about 4 cm. long and 1.1 cm. wide, the upper base truncate to broadly cuneate, the lower base very narrowly cuneate, the apex gradually tapered to an acute point (or rounded in the smaller pinnæ), the midrib slightly falcate, the margins slightly lobed, the lobes about 4 mm. wide, each with 2 or 3 teeth, the basal ones sometimes not toothed; lowest pinnæ with lower base more broadly rounded, and apex rounded. Pinnæ to about 18-jugate, usually separated by about half their own width; texture thin; veins raised on both surfaces, areoles in two series.

Sterile acrophylls. Stipes to 15 cm. or more; frond to 60 cm. long and 20 cm. wide; pinnæ to at least 20-jugate. Largest pinnæ about 12 cm. long and 1.8 cm. wide, midrib slightly falcate, upper base broadly, lower more narrowly cuneate, sides parallel for more than half their length, entire except for the apical third which is distantly toothed (teeth 4–5 mm. apart), apex acuminate. Texture thin; veins raised on both surfaces, usually pale on the lower surface, areoles in about 3 series, costal ones somewhat larger than the next. Lowest pinnæ somewhat reduced, the base more broadly cuneate.

Fertile fronds not seen.

This species is certainly very like *L. Copelandii*. The youngest plants differ from that species in having the apical pinnæ articulate from a very early stage and larger than the others; larger bathyphylls differ in having the lower base of the pinnæ broader, and in a larger number of basal pinnæ reduced and reflexed; acrophyll pinnæ differ in being distinctly toothed towards the apex.

JAVA: *Res. Pasœrœan:* vœt G. Smerœ, 400 m. Posthumus 1613 (P); helling G. Smerœ, 700 m. Posthumus 1621 (P); bij Waterval Sœmberwangi, 300 m. Posthumus 1508 (P, S); helling G. Smerœ 825 m. Posthumus 549 (P, B); helling G. Smerœ 400 m. Posthumus 1608 (P). *Res. Batavia:* Buitenzorg 240 m. Bakhuizen fil. 3123 (B); Sitœhiang 500 m. Bakhuizen 6452 (B,S); Kloof v/d Salak, Bakhuizen 6304 (B); Gœnong Batœ, 250 m. Bakhuizen fil. 3664 (B); Botanic Gardens, Buitenzorg (B), Posthumus s.n. 1925 (P).

SUMATRA. Aer Telani Kloof, 11 km. N. van Banging Agœng, Ranau N. W., 400 m. van Steenis 3951 (B).

8. SPECIES DUBIA

Lomagramma sorbifolia (Willd.) Ching, Lingnan Sci. Journ. 12: 566. 1933.

Aspidium sorbifolium Willd. Sp. Pl. 5: 23. 1810.

This species was described by Willdenow as follows:—

A. frondibus pinnatis, pinnis lanceolatis alternis obtusiusculis, serratis, basi superiore truncato-subauriculatis, inferiore cuneatis, rachi paleacea. W.

Habitat in India orientali.

Caudex filiformis repens glaber, *Stipes* pollicaris glaber. *Rachis* paleis brevibus obsita. *Frondes* quinquepollicares pinnatæ. *Pinnæ* mediæ pollicares, inferiores et superiores sensim breviores, lanceolatæ obtusiusculæ remote serratæ serraturis 5 vel 6 in utroque latere, basi superiore truncatæ, vix manifeste auriculatæ, inferiore cuneatæ. *Costa media* paleis parvis ventricosis obsita. *Soros* perfectos non vidi. W.

Prof. Diels has very kindly sent me a photograph of the type of the species, which is in the Berlin herbarium. As one would anticipate from the description, the specimen consists of bathyphylls from a young plant. The pinnæ are similar in many respects to the lowland species from Java and also to *L. sumatrana, L. grosseserrata,* and *L. Matthewii*. These species however differ very markedly in the apex of the bathyphyll. In the Java fern the apical pinnæ are similar to the others, subequal, and articulated. In the other species the pinnæ are gradually reduced to the apex of the frond, which consists of a narrow lamina continuous with the rachis. Willdenow's specimen has the latter character, and is quite unlike any specimen I have seen from

Java. It is probably one of the other three species, but our present knowledge is not adequate to say which. The only course therefore is to ignore Willdenow's name for the present.

9. DOUBTFUL SPECIMENS

There are several doubtful specimens, some of which may represent new species, but the material is inadequate for a full description to be possible. Some of the specimens may represent bathyphylls of known species; but there is no definite evidence of this. It is clear from the foregoing descriptions that for a full characterisation of a species of Lomagramma all stages of development must be available; species resembling each other at one stage may differ strikingly at another.

LUZON. Rizal Province, Loher 23150 (M). This specimen consists of bathyphylls about the same size as those of *L. Copelandii,* but differing in the shape of the pinnæ, which are more oblique and falcate, the upper base subauriculate, the lower base more narrowly cuneate, the edges not lobed and only irregularly toothed towards the apex. Judging by the bathyphylls of those species in which a number of specimens are available, I do not think it likely that this specimen comes within the range of variation of *L. Copelandii.* It is probable therefore that there is another Philippine species and to it may possibly belong some of those specimens which I have referred to *L. pteroides* or *L. Copelandii,* but until full collections of all stages are available nothing further can be said.

NEW GUINEA. N. New Guinea, H. J. Lam no. 1200, 13-9-1920 (B). This specimen consists of very small bathyphylls, all of about the same size, to about 7 cm. long (including the stipe) and 2.8 cm. wide. The collector noted that the fern was very abundant on the ground and on roots (of trees presumably) but that no fertile fronds could be found. This specimen might perhaps be a very young stage of *L. novoguineensis,* or even of *L. sinuata,* but there is no character in the bathyphylls of Lam's specimen to give a definite connecting link with either species.

CELEBES. Manado Resid., Tomeolama, 700 m. C. A. Wisse no. 71 (B). This specimen consists of four bathyphylls rather similar to those of the specimen from Luzon above quoted, but the pinnæ more regularly toothed. It might well be the same species.

TAHITI. M. Vesco 1847 (M, ex herb. Mus. Paris.). This specimen is the apical half of a sterile acrophyll, which is very near the unnamed Java species in appearance.

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A COMMENTARY ON THE LAWS OF BOTANICAL NOMENCLATURE

By C. X. Furtado,

Botanic Gardens, Singapore

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1. Introduction

Since the main object of the International Rules of Botanical Nomenclature, ed. 3 (1935) is to ensure simplicity and finality in the names and to prevent more than one interpretation to a given name sensu stricto, it is unfortunate that there should exist a good deal of misconception and dissatisfaction over the Rules. But, for the existence of this state of affairs, the Rules

themselves cannot be entirely exonerated from blame. The terms valid and legitimate with their respective derivatives, which have a great importance in botanical nomenclature, have been defined and used equivocally in the Rules; and some nomenclatorial points, where definite instructions are absolutely needed to avoid confusions and equivocations, are left ambiguous. The result is that practices contrary to the spirit of the Rules seem admissible under the letter of the Rules. Already in a small footnote in the GARDENS' BULLETIN, S.S. Vol. VIII, 1935, p. 341, I first drew the attention of botanists to the need of making a clear distinction between the two terms, legitimate (=legal) and valid. In the same publication (l.c. p. 336), I pointed out the necessity of prohibiting the acceptance of a newer interpretation of a name, the type of which is not extant, without showing any adequate botanical reasons for the rejection of earlier interpretation. But as the nomenclatorial laws are of very great importance to systematists, and as in neither of my previous communications have I developed my ideas on the subject to any great length, I make no apology to revert to it here.

2. Definitions of the Terms Valid and Legitimate

A name of a taxonomical group is invalid because certain factors existing in the name itself, or in its botanical description, or in the circumstances affecting the publication of the book or periodical in which the name is published, violate the Rules; that is, the name does not satisfy the conditions prescribed as basic for the words constituting the name, for the words or references constituting its taxonomical description, for the nature of the book or periodical wherein it is published, or for the means taken to make the name known to systematic botanists. Failure to comply with the basic conditions prescribed in the Rules makes a taxonomic name invalid; that is, it does not count, and has no status, in systematic botany; and as such it should not be listed in works like INDEX KEWENSIS.

Examples of invalid names are all nomina nuda; tautonyms; names published since January 1st, 1935, without Latin diagnosis; or published before the starting points prescribed in Art. 20, or in an ineffective publication; names which cannot be considered as belonging to the binomial system; etc. All such names may be conveniently classed as NOMINA INVALIDA.

Taxonomic names that satisfy every one of these conditions are valid; and as these are the only ones that count in systematic botany, they must all be registered in works like INDEX KEWENSIS. Valid names, however, may have been published in violation of another set of conditions or laws that have nothing in common with those mentioned above, and which may be termed secondary or accessory. These conditions are laid

down with the object of ensuring uniformity and finality in the valid botanical nomenclature so as to render it more easily followed by the interested public, without, at the same time, losing the trend of the history of the individual group from its earliest valid origin. Valid names that satisfy all these accessory conditions are legitimate, while those that do not satisfy any one of these conditions are illegitimate.

Though several names may have been validly proposed for a given taxonomic group (*i.e.* a group in a given sense, in a given position and in a given rank), the secondary rules make it impossible for the group to bear more than one legitimate name and regard all the other rival names as illegitimate. Hence an author, having defined his taxonomic group and assembled together all the rival names of the group, should consult the accessory rules in finding out the correct, that is, the legitimate, name for his group. Should opinions differ on a given taxonomic group with regard to its limits, rank or position, so as to permit it being regarded as one according to one opinion, or as two of the same rank, or as one of a different rank, according to another, then an illegitimate name to one botanist will become a legitimate name to another, and *vice-versa*. The main object of the Rules is, therefore, not to interfere with the taxonomic opinions of botanists, but to instruct them as to which of the existing names or epithets should be legitimately used for a given taxonomic group in a given sense, or what conditions should be complied with in order that a certain name may be admitted first as valid and then as the legitimate.

Illegitimate names owe their origin: to their authors' ignorance of the previous systematic work on the subject; to the wrong supposition that the previous illegitimate names are invalid; to faulty judgement or to differences of opinions about the limits of the taxonomic groups involved; to misinterpretation of previously published names; to oversight when in one and the same work the same name is adopted for more than one species, or more than one name for the same species; or also to special decisions of the Congress against the oldest validly published names that are not later homonyms.

Unlike the invalid names, illegitimate names cannot be disregarded in systematic botany, but, like the legitimate names, must be registered in INDEX KEWENSIS, because they effectively preclude one from applying them again legitimately to another and later taxonomic group of equal rank; and also because their status is often a matter of taxonomic opinion so that, as said above, an illegitimate name to one botanist may be legitimate to another. Illegitimate names constitute the synonymy of the legitimate names, and, when cited as such, serve to show how, and possibly, why, the nomenclature of each

individual group has undergone a series of changes from its earliest valid origin as well as to indicate how the opinions of the botanists, who cite them, differ from those of others on the same subject.

Later names of a taxonomic group and later homonyms, if not conserved, are illegitimate. The following two examples may be cited to illustrate the point in question:

(*a*) *Desmos chinensis* Lour. (1790) was published simultaneously with *D. cochinchinensis* Lour. (1790), but the author himself thought them to be doubtfully distinct and suggested the possibility of the former being a variety of the latter. Though there are botanists who regard the species as distinct, in which case both names are legitimate, there are other botanists who consider the species as specifically equivalent. As the names are of the same age, it becomes difficult to decide in this case which of the two should be regarded as illegitimate and which legitimate. The new Rules prescribe to follow the botanist who first decided on the matter; and as in this case it happens that the botanist, who was first to consider these two species definitely as equivalent, had cited *D. chinensis* Lour. as a synonym of the other, *D. chinensis* will have always to be considered as illegitmate whenever it is regarded as being identical with *D. cochinchinensis* Lour.

(*b*) The next example is of two valid genera, the oldest of which is arbritarily made illegitimate by the decisions of the Congress: *Homalocenchrus* Meig. (1760) and *Leersia* Swartz (1788) were published independently, but based on the same type species *Phalaris oryzoides* L. Here though the first name is older of the two, the second is conserved by the Rules and is made thereby legitimate for the group. But as this conservation makes the first name only illegitimate and not invalid, the name *Homalocenchrus* cannot be legitimately used for any other genus in which the type species *Phalaris oryzoides* is not included. In such cases as this there is also the possibility of future decisions reversing the previous ones and making legitimate what is now illegitimate, and *vice versa*.

In order to follow the Rules better, therefore, read: LEGITIMATE for Valid in Arts. 16 and 58; ILLEGITIMATE for illegitimate in Arts. 60 (1-partly), 60 (3), 61, and 69 (partly); VALIDLY for Validly in Arts. 19, 37–40, 42, 45, 48 and 58; VALIDATE for Validate in Arts. 41 and 43, VALID for legitimate in Arts. 20, 45, 56, 60 (2), and 69; VALIDATE for legitimize in Art. 38; INVALID for illegitimate in Arts. 2 (partly), 60 (4–5), 67 and 68; using VALID and LEGITIMATE with their respective derivatives as defined in this paper; though, to make the Rules precise and unequivocal, it would be necessary to state the Rules afresh, changing completely the sections into which they are divided and the order in which the Articles are arranged.

Articles affecting the validity of the names of taxonomic groups are Arts. 19, 20, 36–44, 45 (partly), 59 (partly), 60 (4–5), 67 and 68. All the remaining Rules [*i.e.* Arts. 21–35, 45 (partly), 46–58, 59 (partly), 60 (1–3), 61–66 and 69–74] and Art. 16 (partly) affect the legitimacy.

3. Kinds of Invalid Names, and Nameless Taxonomic Groups

Botanical legislators will do well to recognize the following kinds of invalid names, as such a recognition will make the nomenclatorial laws more precise and unambiguous :—

I. *A name in an ineffective, and therefore invalid, publication.*

Botanically ineffective publications are those that are published in contravention to Art. 36.

In my opinion here should also be included all those publications that ordinarily do not reach systematic botanists *e.g.* modern Encyclopedias and Dictionaries on gardening and on the uses of plant products; seed-lists, seed-catalogues; non-botanical and non-systematic periodicals and books; botanical and systematic books meant to be used as text-books for schools, colleges, etc. As a decision making non-botanical, and non-systematic books and periodicals systematically ineffective may have undesirable effects, time should be fixed (say January 1st, 1941) after which such publications would be considered ineffective.

II. *A name in an effective, but invalid, publication.*

In this class will come all botanical works that have been effectively published, but which, owing to the starting points fixed in Art. 20, cannot be taken into account for systematic purposes; or such works published after the starting points, but where the binary system is not consistently followed throughout, cf. Art. 68 (4).

Should any one in future publish any systematical work without adopting in it the binomial system, that work should, in my opinion, be regarded not only as invalid but also as ineffective, so that it would not be possible to validate new binomials by referring to the descriptions in such works.

The question of validity and effectiveness of works of early modern authors not following consistently the binomial system is *sub judice*, a Committee having been appointed by the last Congress to investigate this matter.

III. *A name in an effective and valid publication.*

Such a name may fall into any one of the following categories :—

(*a*) A validable name but without adequate systematic, or with invalid, description :—

1. A name without any botanical description or without a reference to another effectively published description or plate.
2. A name without a description, but with references not admitted by the Rules.

3. A name with a description, but not in the language prescribed.

(*b*) A validable name with adequate description or references but proposed for adoption in the future should certain expectations come true. Such a description should in my view be regarded as a non-validable description. (Provisional names).

(*c*) A non-validable name but with a valid description (*i.e.* a description that would have been valid had the name been also valid).

1. A name not intended by the author to be a taxonomic name cf. Arts. 67 (1) and 68 (1–2); or coinciding with technical terms to be rejected under Art. 67 (2).

2. A name not belonging to the binary system published as an exception in a book where the binary system is consistently employed cf. Art. 68 (4).

3. A name belonging to the binary system, but a tautonym.

IV. *Nameless Taxonomic Groups.*

This class includes all those taxonomic groups which, though recognized as new and accompanied with valid descriptions, are published without any vernacular or scientific names. They are sometimes separated with difficulty from the Class III-c (1). Such species are sometimes distinguished by the terminology "Species No. I", *"Calamus* cf. *anomalus"*, *"Calamus anomalus?"*, etc.

Failure to grasp these distinctions by the legislators has caused much confusion regarding the proper attitude to be taken towards these invalid names. It is a general, though not apparently universal, custom not to validate a taxonomic name by referring to invalid literature, or to the descriptions of invalid names in valid literature, exception being made to plates and figures in effective but invalid literature in Class II and to valid descriptions in Classes III-c (1–3) and IV and also to species in Linnaeus's *Species Plantarum* ed. 1 and 2. Where reference has been made to a description in an effective but invalid botanical publication (Class II), it has been customary to take this as a reference to the type specimen of the invalid species.

I think a great number of Nomina ambigua, confusa vel dubia would disappear if all botanists were to adopt this attitude in interpreting a name validated by references to effective but invalid publications. References to invalid literature or species do not produce a new isonym (*vide infra* for the definition of this term, section 5), but a new species. Hence despite the citation of an invalid name and even the adoption of its trivial epithet,

the author can, if he likes, choose as the type of his species any specimen, even one that is not included in the invalid references cited, provided the specific description is drawn from it.

Owing to the unintentional omission of significant words, Arts. 37, 42, 43 and 44 of the Rules seem to permit validation of names of taxonomic groups by referring to any sort of invalid names other than nomina nuda, provided the reference has satisfied the conditions imposed in Art. 36 for its effectiveness; while Arts. 43 and 44 seem to admit references to plates invalidly but effectively published. This means that one can validate a name of a species or genus by merely referring to plates (issued before 1908), and descriptions, that have appeared in popular, non-systematic and non-botanical books or periodicals, or to species that have been published after 1934 without any diagnosis in Latin, provided the periodicals and books have complied with the conditions laid down for the effectiveness of their publication.

Such a procedure, if admitted as valid, would violate the very spirit with which the Arts. 37–44 have been inserted in the Rules. In fact I think that it would be to the advantage of systematists in general if, henceforward, only citations of valid species, or of invalid names but with valid descriptions in Class III-c and Class IV should be permissible references for validating a name of a taxonomic group; in future all references to any other invalid names or descriptions, even those in Class II to which reference has been permitted, should be made invalid.

This defect in the Rules can be remedied by inserting the word *validly* after *effectively* in lines 3 of Arts. 37 and 44, and in line 2 of Art. 42; and the word *effectively* before the last phrase *before January 1st, 1908* in Arts. 43 and 44; as well as by taking the word *effectively* in the sense suggested under invalid names of Class I and Class II. But should there be any objections to give the word *effectively* the sense proposed above, it is necessary to define *valid publications* as being those that ordinarily reach systematic botanists, a provisional exception being made to periodicals like the Indian Forester, *Journal of Royal Asiatic Society, Malayan Branch, Gardeners' Chronicle,* etc. which are not purely botanical periodicals. But publications, which their titles indicate to be purely zoological, ethnological, geological, medicinal, etc. and which should therefore have nothing to do with systematic botany, or which belong to the class of modern dictionaries and encyclopedias on gardening or plant-products, botanical text-books for schools and colleges, and seed-lists, should, for the purpose of systematic botany, be declared invalid, even when they are effectively published. It would then be a very simple matter to rule out as invalid all taxonomic names published in invalid publications, as well as such as have been published merely by references to descriptions or figures in invalid publications. A ruling like this would, for

instance, invalidate the alga, *Rhopalodia vermicularis* O. Müll forma *recta* Fl. Rich in Journ. Linn. Soc., Zoology, XXXVIII (1933) 262.

The Rules are ambiguous as to the status of the names published in the direct contravention of Arts. 54, 59 and 69, so that it is not possible to decide whether the names thus published are valid but illegitimate, or invalid. In this matter Art. 60 is also ambiguous (*vide* my remarks in Section 6, p. 235). A definite ruling on this matter is necessary as it affects the status of homonyms and consequently the legitimacy of certain names rejected as later homonyms.

4. Provisional Names

A new amendment made to the Rules at the last Congress (1935) regards provisional names as invalid, but no adequate description or examples are given to show exactly what a provisional name is. The clause regarding the provisional names reads as follows:—"A name of a taxonomic group is not validly published unless it is definitely accepted by the author who published it. A name proposed provisionally (nomen provisorium) in anticipation of the eventual acceptance of the group, or of a particular circumscription, position, or rank of a group, or merely mentioned incidentally is not validly published".

Now the effect of the first sentence of this decision will have far reaching results, and, if put into practice, may produce chaos and confusion, requiring a lengthy list of nomina generica et specifica conservanda.

(1) *Epipremnum humile* Hook. f., *Fl. Brit. Ind. VI* (1893) would become invalid because of the author's following remarks on the genus: "This genus [*Epipremnum*] had better be merged in *Rhapidophora*."

(2) *Plectocomiopsis dubius* Becc., which has been described at some length in *Ann. Roy. Bot. Gard. Calc. XII* (1918) 56, will suffer the like fate because of the following observations: "It is a very imperfectly known and doubtful species,————We may even suppose that *P. dubius* represents a juvenile stage of *P. Wrayi*————In conclusion, *P. dubius* established on Ridley's n. 12119 must be considered as yet as a doubtful species, but not certainly referable to *P. geminiflorus* as has been stated by Ridley————".

(3) *Desmos chinensis* Lour. will cease to have any valid status because the author had added to the description the following words: "fortasse illius varietas".

In each of these cases, the author may be interpreted to mean that there are reasons to doubt the delimitation of the genus or species concerned, but that he leaves the subject to future botanists, whose attention he wishes to draw by his remarks. At present he is content with the names he has adopted and described.

A parallel case is also of *Cyrtophyllum? lanceolatum* DC. *sp. nov.* Prodr. IX (1845) 31. Here the author means that he is pretty sure that the species as represented by the specimen he has

described is a new species; and that though his material is either aberrant or insufficient to say definitely whether it belongs to *Cyrtophyllum* or to any other closely allied genus, the author assigns it to the genus *Cyrtophyllum:* Let the future investigators transfer the species to another genus if they disagree with his disposition.

If botanists are to reject the above species on the plea that the author in each case did not accept definitely the genus or species, then this rejection is going to create a very bad precedent which, as said above, will have to end in a creation of a lengthy list of nomina generica et specifica conservanda to prevent chaos and instability in nomenclature.

Similarly I consider that the name *Neurotecoma* K. Schumann is validly published, though the author considered the material at his disposal insufficient for a thorough investigation. If it is invalid, as proposed in Briquet's *Recueil Synoptique* p. 41, 1930, and declared by the last Congress (1935), because of certain words contained in its description, then *Spirotecoma* Baill. *ex* Dalla Torre et Harms is also invalid because the last two authors did not make any exclusion from Schumman's description, but meant that *Spirotecoma* Baill. was synonymous with *Neurotecoma* Schum. Further, as explained above, the practice of validating a name by referring to an invalid description, or to a description that, though published in a valid publication, does not belong to Class III-C and Class IV, is not supported by usage and therefore needs condemning. If in the description or remarks there were certain words that made the genus *Neurotecoma* invalid, the words were not excluded by Dalla Torre and Harms in their citation. Had they described the genus, then the description, and not the citation, would have validated the genus *Spirotecoma.*

A parallel may be found in the case of nomina confusa. If a nomen confusum is used as a basinym without showing exactly what portions from the description and what specimens are to be excluded from the basinym*, then its isonym* becomes also a nomen confusum. If this interpretation of the provisional names is not accepted, then it will be possible to validate a name by referring to an invalid description; and it will also mean that invalid provisional names will become valid by merely registering them in works like the *Index Kewensis.*

According to my view, the names in the following sentences are invalid and cannot be used as basinyms:—

(1) "If this section [*Mesembryanthemum* sect. *Minima Haw.*] proves to be a genus, the name of *Conophyton* would be apt" (Haworth, *Rev. Gen.* 1821 p. 82).

(2) "The anther-appendage is analogous to that of *Doryphora;* consequently this *Eupomatia* [*E. Belgraveana* F. Muell.] might subgenerically or perhaps even generically be separated (as *Himantandra*)" (*Australas. Journ. Pharm.* Jan. 1887). (cf. also Alternative names).

* These terms are explained on p. 233 under exact synonyms.

(3) Should Beccari's supposition that *Ptychosperma angustifolium* Bl. is identical with *Coleospadix oninensis* Becc., accord with actual fact, then *Coleospadix angustifolius* (Bl.) would be the correct name (hypothetical case).

(4) I make the new combination *Coleospadix angustifolius* (Bl.) to be used instead of *C. oninensis* Becc., should Beccari's surmise that this species is identical with *Ptychosperma angustifolium* Bl. turn out to be correct (hypothetical).

(5) If Curtis's specimen from Penang proves to represent a species different from *Pothos Maingayi* Hook. f., then it might be called *P. Curtisii*. The latter may be described or distinguished as follows :—.....(hypothetical).

But if, instead, a different wording was used so that not the adoption, but the rejection, of the names proposed was made dependent on future investigations, I think the names could be regarded as valid, and could be used as basinyms for making new binomials. These sentences (1)–(5) might be turned in this way so as to validate the new names :—

(1) I think this section should be raised to a generic rank. I propose to name it *Conophyton*. [In this case *Conophyton* Haw. would have been an alternative name to *Mesembryanthemum* sect. *Minima* Haw. See below my remarks on alternative names].

(2) *Eupomatia Belgraveana* F. Muell. is so distinct that it would be better, I think, to make it the basis of a new genus *Himantandra*. The anther-appendage of this species is analogous to that of *Doryphora*, and differs from other Eupomatia species————.

(3) Beccari thinks that *Coleospadix oninensis* Becc. is identical with *Ptychosperma angustifolium* Bl. Though this cannot now be proved beyond all doubt, for there is no type specimen of the latter, I think it is better to follow Beccari in this matter. I therefore make the new combination *Coleospadix angustifolius* (Bl).

(4) On the supposition that Beccari's opinion is correct that *Coleospadix oninensis* Becc. and *Ptychosperma angustifolium* Bl. are the same species, I make the combination *C. angustifolium* (Bl). to be used as the legitimate name for *C. oninensis* (Becc.).

(5) Curtis's specimen resembles *Pothos Maingayi* Hook. f. so very closely that I hesitate to describe it as specifically different, but flowers are more than twice as large as in that plant,————. I name it provisionally as *Pothos Curtisii* Hook f. Further studies might show it to be a mere form or variety of *P. Maingayi*.

or : this specimen, though it resembles very much *Pothos Maingayi* Hook. f., might be specifically separated under the name *P. Curtisii*, for it differs from *P. Maingayi* in————.

5. Kinds of Illegitimate Names or Synonyms

Some botanists have tried to subdivide illegitimate names or synonyms of a taxonomic group into names that are valid (or legitimate) and invalid (or illegitimate). But they have been unable to dissociate from these terms also the sense given in this paper and have succeeded in creating a great deal of confusion and equivocation on the matter; and as the Rules of Nomenclature have not escaped from these confusing notions, it seems useful before proceeding further to pause a while and inquire into the

exact nature of the three main classes into which synonyms may be subdivided :—

1. ABSOLUTE OR EXACT SYNONYMS are illegitimate names based on the same specimen, or a duplicate from the same type collection or from the same type plant, as the one on which the legitimate name was based. For the oldest name on which all new names and new combinations have been based I propose the term **BASINYM,** and for all the new names and new combinations based on the basinym the term **ISONYM.** Taxonomic groups published independently as new species, but based on the type specimen of a valid name, or on a duplicate of the type specimen, are called **TYPONYMS.** A legitimate name may itself be a basinym or an isonym : if the former, it will have at least one isonym as its absolute synonym; if the latter, it will have one basinym as a synonym, though it may also have in its synonymy one or more isonyms. In either case there may also be one or more typonyms, in relation to which the legitimate name itself might be regarded as a typonym.

The following two examples will show how these terms are applied :—

(*a*) Both *Unona cochinchinensis* DC and *Unona Desmos* Dunal were based on *Desmos cochinchinensis* Lour., the second as a new name and the first as a new combination for the third name. *D. cochinchinensis* is, therefore, the basinym of the first two, both of which are its isonyms. In this instance *Desmos cochinchinensis* Lour. is also the legitimate name under the genus *Desmos,* the genus *Unona* being reserved for American species. Had the generic name *Unona* been applicable legitimately, *Unona cochinchinensis* (Lour.) DC would have been the legitimate name, while the other two binomials (one an Isonym and the other a basinym) would have to be quoted in the synonymy.

(*b*) *Actinophloeus cuneatus* Burret (1931) was based on a specimen derived from a plant cultivated in the Botanic Gardens, Buitenzorg, Java, under the gardens' no. V–I–16. Quite independently of this name, *Ptychosperma tenue* Becc. (1934) was described as a new species having for its type another specimen derived from the above mentioned plant from the Buitenzorg Botanic Gardens. Later on, with the first species for its basis, the new combination, *Ptychosperma cuneatum* (Burr.) Burr. (1935) was made. Here *Actinophlœus cuneatus* Burr. is the basinym of *P. cuneatum* Burr. and conversely *P. cuneatum* Burr. is the isonym of the former. Both these are typonyms of *P. tenue* Becc., and vice-versa. (see also the example in 2).

2. EQUIVALENT SYNONYMS have more or less the same particular circumscription or concept as the legitimate name, but are not based on the same type specimen, or its duplicate. Some of these may have been published originally as distinct from those to which they are now united, and possibly may have been based on the paratypes or the lectoparatypes of the species to which they are now reduced. Though they may have been generally accepted as identical or equivalent synonyms, some authors, particularly "splitter" botanists, may recognize in them as many species in the Jordanian sense as there are names.

Such names, even when cited in the synonymy, have been called legitimate names in the example given under Art. 60 (1) of the Rules; but it is evident from the definitions given in this paper, it is a misnomer to class them as such. They may be legitimate if they are maintained as independent species; otherwise they must be considered as illegitimate names.

Examples :—

(*a*) If, in the case of *Cucubalus* treated in the example under Art. 60 (1) of the Rules, one follows Miller and considers *C. latifolius* Mill. (1768) and *C. angustifolius* Mill. (1768) as two separate species distinct from *C. Behen* L. (1753), then Miller's binomials are legitimate; but if one follows other authors and regards Miller's species as synonyms of *C. Behen* L., then both Miller's names become illegitimate for *C. Behen* L. and equivalent synonyms of it.

(*b*) Blume, working out the plants cultivated in the Botanic Gardens, Buitenzorg, published *Calla silvestris* Bl. (1823), which later became the basinym of *Raphidophora silvestris* Engl. (1879). Hooker, studying the flora of the Malay Peninsula, found a *Raphidophora* plant that was not credited for the region under his purview, and which he described as *R. Wrayi* Hook. f. (1893). Later Ridley, examining the species of *Raphidophora* from Borneo, detected one that was not recorded for the country, and proposed *R. nigrescens* Ridl. (1905) as a name for it. Now it has been found out that, though the types of each of these species were derived from three different collections made in three different countries, nevertheless all the three species represent one and the same species. As *Calla silvestris* Bl. is the oldest of the three binomials published as new species, its isonym, *R. silvestris* (Bl.) Engl., becomes the legitimate name for the group under *Raphidophora,* with *R. Wrayi* Hook. f. and *R. nigrescens* Ridl. as equivalent synonyms and with *C. silvestris* Bl. as the absolute synonym.

3. Besides the two classes enumerated above there are synonyms which consist of names based on monstrosities; and of nomina dubia, confusa vel ambigua. These together with such synonyms of the above three classes as have been rejected by the special decisions of the Congress (nomina rejicienda) may be termed NOMINA EXCLUDENDA.

6. Legitimate Names (Arts. 69 and 60)

To the followers of the modern, so-called binomial, system of plant nomenclature, there is no Article more important in the new Rules of Botanical Nomenclature than Art. 69. It forms the basis of all the other regulations framed with the view to laying down the correct procedure to be adopted in putting the principle of priority in force. Almost all the illegitimate names, that could have been avoided by authors at the time of publication, have been published because the questions dealt with in this Article have been much disputed even by the staunchest supporters of the priority principle. And it is no exaggeration to say that this Article, if it had been properly worded and quoted, would have saved several botanists from being confused by the Rules and would have perhaps rendered some other Articles like Arts. 53–55 unnecessary or made them mere

sub-divisions of Art. 69. Yet students of the Rules note with vexation that this Article is given a secondary importance and that it is even ignored in Articles where reference to it is absolutely due. The chief defects in Art. 69 may be summarized as follows:

In the first place this Article, which forms a part or the basis of Arts. 53–55, is misplaced so as to be easily overlooked by botanists consulting the Rules for definite instructions on the retention of names and epithets of groups below the rank of genus (Sect. 9–11, Arts. 53–58), or even on the RETENTION OF NAMES AND EPITHETS OF GROUPS BELOW THE RANK OF GENUS ON TRANSFERENCE TO ANOTHER GENUS OR SPECIES, which is the title of the Section 9, Arts. 53–55. In the second place, Art. 69 is not referred to in Art. 60 (1–5) where illegitimacy of names is defined; consequently it might easily lead one to the erroneous conclusion that, though the violation of Art. 54 renders a binomial illegimate [Art. 60 (2)], the violation of Art. 69 does not. In the third place the terms legitimate and illegitimate are used equivocally both in the text and the example. And in the fourth place, Art. 69 leaves the point ambiguous when, after discarding all names regarded as not available or illegitimate under Arts. 60–68, there are yet available for the taxonomic group more than one name that is considered "not illegitimate" under Art. 60 (1).

In order to be able to discuss Art. 69 fully, it may be useful to transcribe here the text and the examples in extenso:—

"In cases foreseen in Art. 60–68 the name or epithet to be rejected is replaced by *the oldest legitimate name*,* or (in a combination) by the oldest legitimate epithet which will be, in the new position, in accordance with the Rules. If none exists, a new name or epithet must be chosen. Where a new epithet is required, an author may, if he wishes, adopt an epithet previously given to the group in an illegitimate combination, if there is no obstacle to its employment in the new position or sense.

"Examples: *Linum Radiola* L. (1753), when transferred to the genus *Radiola*, must not be called *Radiola Radiola* (L) Karst., as that combination is contrary to Art. 68 (3): the next oldest specific epithet is *multiflorum*, but the name *Linum multiflorum* Lam. (1778) is illegitimate, since it was a superfluous name for *Linum Radiola* L: under *Radiola* the species must be called *R. linoides* Roth (1788), since *linoides* is the earliest legitimate epithet available. The combination *Talinum polyandrum* Hook. (in *Bot. Mag.* t. 4833: 1855) is illegitimate, being a later homonym of *T. polyandrum* Ruiz et Pav. (*Syst. Fl. Per.* I, 115: 1798): when Bentham transferred *T. polyandrum* Hook. to *Calandrinia*, he called it *Calandrinia polyandra* (Fl. *Austral.* I: 172: 1863). This is treated, not as a new combination, but as a new name, *C. polyandra* Benth. (1863)".

If the word legitimate in the text is taken in the sense defined in the footnote to Art. 45, and, therefore, in the sense given in this paper, then the Article ceases to be an instruction, for a taxonomic group can bear only one name that is "strictly in accordance with the Rules" (=legitimate). Should the Rules

* Italics are mine.

make it possible for a taxonomic group to bear more than one legitimate name, then the element of simplicity, uniformity, definiteness and stability will at once disappear from plant nomenclature. The Rules do not admit, therefore, an old or older, or the oldest, legitimate names.

If, as in Arts, 20, 56 and 60 (2), the word legitimate is taken to mean valid as defined here, the first sentence of the text of Art. 69 will have a meaning, but nevertheless the instructions will be far from clear. In the first place it will be seen that the word illegitimate in the text and in the examples cannot be taken to mean invalid. As it might mean illegitimate in the sense given to the term in Art. 60 it will be worth while, at this stage to analyse this Article also.

It is obvious that the word illegitimate, as interpreted in Art. 60 (2–3) means illegitimate; and as interpreted in Art. 60 (4–5) means invalid; both in the sense given here. But to give a precise interpretation to it as used in Art. 60 (1) is an impossibility, despite the definitions and examples given. I surmise that in the first (*Cainito*) and third (*Chrysophyllum sericeum*) examples, an illegitimate name means either an invalid (or illegitimate?) name published in contravention to Art. 59, or a later typonym, when the earlier name was legitimate; or perhaps a new name published illegitimately when a new combination was possible.

In the second example (*Unisemà*), illegitimate might be taken to mean illegitimate as defined in this paper; and in the fourth example (*Cucubalus*) the phrase " not illegitimate" might be taken to mean not "not invalid" but illegitimate under certain conditions and legitimate under others; for this is a case of a synonym belonging to the EQUIVALENT class (example *a*).

With such different and ambiguous meanings given to one word and in one Article, how can Art. 69 be clear and unequivocal? Is *Linum multiflorum* Lam. referred to in the first example under Art. 69 an invalid name (which it does not appear to be) or a later typonym or isonym? Why after the exclusion of *Radiola,* is the trivial name *linoides* " the earliest legitimate epithet available", and why should the binomial *R. linoides* Roth have priority over *L. multiflorum* Lam.? Is *R. linoides* Roth an equivalent synonym of *L. Radiola* L.? In a hypothetical case, if the species *L. Radiola* L. had to be transferred again to a new genus where the specific epithet *Radiola* could not be used, is the author effecting the transference obliged to adopt again the later specific epithet *linoides* and definitely reject *multiflorum?* Since from the text and the examples under Arts. 60 and 69, it is not possible to give definite answers to these questions, it is no wonder that botanists find the Rules as confusing as ever, and go on creating new binomials knowing fully well that many of them will have to be rejected later as illegitimate.

7. Three Customary Procedures Affecting Art. 69

I enumerate here three practices that are current among the supporters of the priority principle, one of which may be legitimized under the Rules. In this exposition I leave tautonyms and names of unequal rank out of consideration. The reasons for excluding these are:—(*a*) According to the definitions given above, tautonyms are invalid names, and therefore, must not enter into nomenclatorial considerations. (*b*) The practice of taking into account names of unequal rank for the purpose of priority is almost dead and is moreover, condemned by Art. 58 of the Rules. For the purpose of priority and legitimacy only valid names of the same rank as the corresponding taxonomic group under consideration are to be taken into account. The procedures may be enunciated thus:

When there are available for a taxonomic group several rival names of equal and corresponding rank, reject all Nomina Excludenda because their status is doubtful or ambiguous, or because they have been excluded once for all by special decisions of the legislative body. After having done this, then adopt any of the following procedures:

(1) Of the remaining rival names, *omit also the later homonyms;* then in the case of the names of a family or a genus, the oldest name becomes also the legitimate name. In the case of the subdivision of a genus, or of a species or a variety, the epithet of the oldest name of corresponding rank becomes the legitimate; but if this epithet cannot be used in the new, required position, because of the resulting tautonym or later homonym, then *the oldest name of equal rank already existing in the required position* becomes the legitimate name for the group. If none exists, the author is free to choose any epithet he likes, being allowed also to use the epithet from any of the several synonyms and homonyms, irrespective of their age, provided its use does not create a tautonym or a later homonym.

(2) For the first part follow the procedure as enunciated in (1); but in a new combination where the oldest epithet cannot be legitimized for the taxonomic group below the rank of genus because of the resulting tautonym or a later homonym, the author must adopt the epithet from *the next oldest name* that can be used, without producing a tautonym or a later homonym, *regardless of the required position.* If none exists, then the author is free as in (1) to apply any legitimable epithet he chooses.

(3) The third procedure is to *include all valid names* that are not nomina excludenda, so that in the case of a taxonomic group of the rank lower than a genus, *later homonyms are also taken into account.* In the case of the names of families and genera, the legitimate name is the oldest name of the corresponding rank that is not a later homonym. In the case of names of the sub-

divisions of a genus, or of the species, and the varieties, choose as the legitimate epithet for the group, the one from the oldest name of corresponding rank, unless the epithet thus chosen either is in the required position a later homonym, or when transferred to the required position, produces a tautonym or a later homonym. If either of these obstacles exists, then *the next oldest epithet* that can overcome both these obstacles must be used as the legitimate epithet for the group. If none exists, then the author is free to choose any legitimable expithet he likes.

Examples:—

(*a*) Assuming *Linum Radiola* L. (1753), *L. multiflorum* Lam. (1778) and *Radiola linoides* Roth (1788) given in the example under Art. 69 to be all valid names, *R. linoides* Roth is the legitimate name for the species according to the first procedure, because the oldest specific epithet cannot be used under the genus *Radiola,* and because *R. linoides* Roth is the oldest name under *Radiola.* In the next example Bentham was not obliged to adopt the specific epithet *polyandra* when he transferred *Talinum polyandrum* Hook. to the genus *Calandrinia* because *T. polyandrum* Hook. was a later homonym.

(*b*) According to the second procedure, one is bound to adopt the epithet *multiflorum* under *Radiola,* because *L. multiflorum* Lam. is the next oldest name; but one is not obliged to adopt the specific epithet *polyandrum* under *Calandrinia,* for *Talinum polyandrum* Hook., because this was a later homonym.

(*c*) According to the third procedure, the author is bound not only to adopt the specific epithet *multiflorum* under *Radiola,* but also to use the epithet *polyandra* under *Calandrinia,* because *Talinum polyandrum* Hook. is the oldest valid name for the species and the specific epithet can be legitimized under *Calandrinia.*

The first procedure is not followed generally by strict supporters of the principle of priority. It seems probable that, in drafting Art. 69 of the Rules, the legislators had this procedure in mind. The second may be considered a reasonable procedure, but it has never received any great support from the followers of the priority principle. The third procedure is the most favoured of all the three practices. And as it follows, from the provision made at the last Congress (1935) for validating and legitimizing alternative names (*see* below for the definition) even though the basinym is a later homonym, that the practice of basing a new combination on a later homonym cannot be entirely condemned, the third procedure appears to me the most natural outcome of putting the principle of priority in practice. Besides under the priority principle the epithet for the correct rank of a taxonomic group is of greater importance than its disposition in the correct genus or family.

One of the principal reasons why some botanists object to the second and the third procedures indicated above is that they think that it should never be possible to legitimize a name published in contravention of the Rules. But even if the first procedure was adopted as a rule, it would not be possible to

achieve this object in every case, as it will be seen from the following hypothetical case:

Supposing *Linum multiflorum* Lam. in the above example was a valid and legitimate species quite distinct from *Linum Radiola* L. and *Radiola Linoides* Roth, and Roth, in transferring that species to the genus *Radiola,* had used the epithet *pauciflorum,* rejecting *multiflorum* as unsuitable for the species, then Roth's *Radiola pauciflorum* nom. nov. would contravene Art. 59 of the Rules. Now if someone were to publish the name *Radiola multiflorum* for a new species, then *R. multiflorum* (Lam.) comb. nov. would not be legitimable, and, owing to the reservation of this binomial for the new species, *R. pauciflorum* nom. nov., although published in contravention of the Rules, would become automatically the legitimate name for *L. multiflorum* Lam. under the genus *Radiola,* unless legislation is passed invalidating all the names published in contravention to Art. 59.

8. What a New Combination or a New Name is

These terms are so familiar to any taxonomist that it might appear fatuous on my part to try to explain them here. But as they are not defined in the Rules and as in one instance at least, they seem to have been mis-stated, it appeared to me that a consideration on the matter would not be out of place.

Both a new combination and a new name are validated by citation so that both these terms imply the existence of a basinym on which each is based, though, as explained above, a basinym may have, for its isonyms, both a new name and a new combination at the same time. But all basinyms must be valid names; consequently a species, published by referring to an invalid, or pre-Linnean, name, figures and description cannot be called either a new combination or a new name, but must be called a new species. If the specific epithet in the basinym and in its isonym is the same, then the isonym is called a new combination; if the specific epithet in the basinym is different from that of its isonym, then the isonym is a new name. According to this definition, *Calandrinia polyandra* Benth. in the second example under Art. 69, must be called a new combination based on *Talinum polyandrum* Hook., and not a new name as stated in Art. 69.

9. Alternative Names

Now alternative names (nomina alternativa seu eventualia) are generally new combinations published simultaneously with the basinym, though there is nothing in the new provision passed at the last Congress, to deter one from making alternative names that are new names (*vide infra*). In the example of alternative names discussed at the last Congress, the alternative name *Andropogon Bequærtii* De Wild. was quoted as *nom. nov.* of *Cymbopogon Bequærtii* De Wild. *sp. nov.;* but the distinction between new names and new combinations was not considered.

The practice of publishing alternative names has had an origin which, though not made clear at the last Congress, appears

to me quite sound. There are genera like *Andropogon* and *Cymbopogon*, *Ptychosperma* and *Actinophlœus*, and *Pasania* and *Lithocarpus*, where it is not yet possible to decide definitely whether it is better to split a genus into two or more genera, or to keep it entire and divide it into so many sections or subgenera. Specialists find as many good reasons in favour of the first alternative as they do in favour of the second. Now if an author accepted such a genus sensu lato and published new species in a section of such disputable status, a botanist in search of easy honours might at once seize the opportunity, whether he had himself studied the group or not, to make new combinations under the alternative and disputed genus based on the binomials of the first botanist; or *vice-versa*, had the specialist published the new species under the latter genus, it would not have deterred the second botanist from making new combinations under the former. In such a case, though the second botanist might have no opinion of his own on the genera and might even be utterly unacquainted with them, the Rules would oblige one, as they do even now, to accept the new combinations made by him. It is to curtail such vexatious activity, and also to keep the honour where it is due, that the practice of publishing simultaneous isonyms or alternative names has arisen. Therefore it was but just that it was validated by the last Congress.

I think it is necessary to make additions to this amendment prohibiting alternative names that are not new combinations and also alternative names of a different rank from the basinym. According to these provisions *Conyphyton* or *Minima* could not be proposed as an alternative name to *Mesembryanthemum* sect. *Minima*, nor *Cymbopogon fluminense* var. *riparium* to *Cymbopogon riparium*, as these names belong to different ranks; neither *Cymbopogon riparium* or *Andropogon riparium* could be proposed as alternative to *Cymbopogon fluminense*, because the trivial epithets are different. Without such an amendment, new names or new combinations of equal and unequal rank could be proposed as alternative names.

10. Rival Names of Equal Age and Equal Rank (Arts. 56 and 61)

When for one species there are available two or more valid names of equal age, then Art. 56 instructs us to follow the botanist who first preferred one of them as the legitimate name for the species. It should have been added here that, if the name first chosen cannot be legitimized, then the author who is first to choose the next legitimable name must be followed.

When one and the same name is used simultaneously for more than one species, according to the new addition to Art. 61, "the first author who adopts one of them, or substitutes another name for one of them, must be followed".

In cases foreseen in Arts. 56 and 61 I think it is necessary to give new combinations a precedence over new names; and these over new species. Again when homonyms of equal age are isonyms of equal kind, those which have older basinyms should be preferred. The reason for this preference is that, though the age of a binary or ternary name is counted from the time it is published in its correct position and rank in a genus or a species, the age of the epithet itself is counted, according to the priority principle, from the date of its first publication in the same rank for the group but independently of the position regarding its family, genus or species, so that when a new species is older than a homonymous new combination, the former takes precedence; but when they are of equal age, the principle of priority should oblige one to give precedence to those isonyms which have the oldest basinyms.

Thus, whenever *Colocasia esculentum* (L. 1753) Schott (1832) and *C. antiquorum* Schott (1832) isonym of *Arum colocasia* L. (1753) are regarded as synonymous, the former should be chosen as the legitimate name for the taxonomic group thus constituted. So also whenever one of these is to be reduced as a variety of the group, it would be the new species, and not the new combination, that would have to be relegated to the varietal rank.

Further it is also necessary to add here that the choice made under Arts. 56 and 61 holds effective so long as the species or names remain in the same genus under which the choice was made; but on their transference to another genus, the author who first made the distinction in the new position must be followed, provided this distinction does not conflict with the rule of precedence.

Thus, even when someone had discovered that *Arum colocasia* L. (1753) and *A. esculentum* L (1753) were synonymous and reduced the latter to a synonym of the former, Schott (Syn., 1856, p. 41) would not have been justified in reducing *A. esculentum* L. (1753) to a synonym or variety of *Colocasia antiquorum* Schott (1832)=isonym of *A. colocasia* L. (1753); for such a reduction is inadmissible under the priority principle, as it would mean giving to a younger epithet precedence over an older one, when the latter is legitimable in the required position. Hence Hubbard and Rheder (Bot. Mus. Leafl. Harvard Univ. I, 1932, No. 1 p. 5) are justified in publishing the combination, *Colocasia esculenta* (L) Schott (1832) var. *antiquorum* (Schott) Hubb. et. Rhed. (=*Colocasia antiquorum* Schott) without first inquiring into the history of their respective basinyms, *Arum esculentum* L. and *A. colocasia* L., But it seems to me that the combination *Colocasia esculenta* (L) Schott. var. *colocasia* comb. nov. (=*A. colocasia* L.) would not have been contrary to the Rules as they stand. (see also the examples in the next section 11).

11. Isonyms of Unequal Age based on Basinyms of Equal Age

As proposed above, under equal circumstances isonyms that are new combinations should have precedence over new names. But the case where the basinyms are of equal age but their isonyms are of different ages, has so far remained untreated. From a study of the recent works of eminent taxonomists, it is evident that there is no fixed procedure for dealing with the

case; but, as a general rule, I think that the isonym which is the older or the oldest should take precedence. Thus, of names *Bruguiera gymnorrhiza* (L.) Lam. (1797) and *B. conjugata* (L.) Merrill (1914) which were based on basinyms of equal age, *Rhizophora gymnorrhiza* L. (1753) and *R. conjugata* L. (1753), botanists should, in my opinion, be obliged to adopt *B. gymnorrhiza* (L.) Lam. as the legitimate name whenever the two species are regarded as conspecific. At least that has been the procedure long current among the strict supporters of the priority principle, though some botanists of high reputation have now begun to use the younger of the isonyms as the legitimate.

However this rule of procedence, if followed in every case, might seem to give rise to difficulties. Suppose, before Lamarck made his combination, *B. gymnorrhiza,* a botanist had detected the identity of the two species and reduced *R. gymnorrhiza* L. as a synonym of *R. conjugata* L., then under Art. 56, *R. conjugata* L. has to be retained as the legitimate name whenever the two are retained under the genus *Rhizophora* and are considered as conspecific; but it does not say anything if Lamarck, in transferring the species to *Bruguiera,* had inadvertently or deliberately, made the new combination with *R. gymorrhiza* L. as the basinym and with or without *R. conjugata* L. as a synonym. To some this combination might seem illegitimate and they might be tempted to consider, under such circumstances, *B. conjugata* (L) Merr. (1914) as the legitimate name. But not only under the rules of precedence but also under the most common procedure affecting the priority principle, *Bruguiera gymnorrhiza* (Linn.) Lam. (1797), being the older of the two isonyms of the basinyms of equal ages, is the legitimate name under *Bruguiera.*

Such cases mentioned here and in section 10 are extremely rare; but they show the effectiveness of the strict application of the rule of precedence in preventing usages that are contrary to the accepted principles of nomenclature and in ensuring simplicity and uniformity in the solution of such complicated problems.

12. Varietal Names

Of late there has been a tendency to regard a specific name (even when the species itself was originally described from a single type specimen) as a conglomeration of varieties and then to give each variety a separate name. In naming the varieties two common procedures exist: the first is to call *var. genuina, typica, primitiva, communis,* etc. the form that the author, who makes the separation into varieties, considers as the most primitive or the most common of the varieties, it being immaterial whether this form agrees with the type of the species or not. If the type form does not agree with the so-called primitive or common form, then the type form receives another varietal name. The second procedure is to call *var. typica, genuina* or *originaria* the type form (*i.e.* the form that agrees with the type specimen) and to give new names to other forms. The latter procedure is approved in the Recommendation XVIII of the Rules, while the first, though not expressly condemned, is being abandoned by botanists. But I consider that even the

second procedure is wrong and, if admitted as valid, gives rise to combinations that are contrary to the spirit of the Rules themselves and that might not be in accordance with either of the procedures mentioned above.

Thus *Colocasia esculenta* (L) Schott var. *antiquorum* (Schott) Hubbard et Rheder (1932), being a later isonym of equal rank for *C. antiquorum* Schott var. *typica* Engl. (1879), would have to be called *C. esculenta* (L) Schott var. *typica* (Engl.) com. nov., a combination that might not be applicable either to the type of the species or to the most primitive or the most common form. Further since the Rules themselves do not condemn the procedure which admits giving a new varietal epithet to the type specimen of a species, while using such terms as *typicus, primitivus,* or *communis* for the form which is either the commonest in the wild state or the most primitive, it appears that one cannot consider invalid the trinomial *Aglaonema angustifolium* N. E. Brown var. *undulatum* Ridley (Mat. Fl. Malay. Pen., Monocot., III, 1907, p. 21), although the varietal name is given exactly to the same form as represented by the type of *A. angustifolium* N. E. Br. (1895).

Engler reduced *Aglaonema angustifolium* N. E. Br. (1895) to a synonym of *A. Schottianum* Miq. (1856) and named the form represented by Brown's type (*A. angustifolium* var. *undulatum* Ridl.) as *A. Schottianum* Miq. var. *Brownii* Engl. (Pflanzenreich, hft. 64, 1915 p. 21). But under the priority principle this varietal name of Engler's cannot be the legitimate one, since of the two varietal names, *undulatum* (1907) and *Brownii* (1915), the former is both legitimable under *A. Schottianum* Miq. and earlier.

Further Ridley mentions the "typical form" (*i.e.* the common form) of the species, *A. angustifolium* N. E. Br., but does not give it a name. Had he called it var. *typicum,* then on its transference to *A. Schottianum* Miq., we should have, side by side with *A. Schottianum* Miq. var *genuinum* Engl. (1915) containing the type of the species, *A. Schottianum* Miq. var. *typicum* comb. nov., not containing the type, and with the possibility that neither of the varieties represented the commonest form of the species when viewed in the broad sense.

The other alternatives are either to repeat the specific epithet (recommended under the Rules, Rec. XVIII), or to regard *C. antiquorum* Schott as equivalent to *C. antiquorum* Schott, subsp. *antiquorum* Schott, var *antiquorum* Schott, forma *antiquorum* Schott. In the last case the Recommendation XXXVI (2) will automatically become a rule and oblige botanists to choose *antiquorum* as the legitimate epithet whenever *C. antiquorum* is reduced to a variety or a subdivision of another species. This would necessitate an alteration in the text of Art. 58.

But to admit such names as *Colocasia antiquorum* var. *antiquorum* or *C. antiquorum* var. *genuinum,* and *Aglaonema angustifolium* var. *augustifolium, A. angustifolium* var. *undulatum,* or *A. angustifolium* var. *typicum* (or genuinum etc.) all referring respectively to the type of *Colocasia antiquorum* Schott and *Aglaonema angustifolium* N. E. Br. would be tantamount to adopting ternary specific names in modern botanical nomenclature and to making the present obligation to use the binary names for species a farce or non-obligatory. Further, an

acceptance of such ternary names will, in turn, have to be followed by the removal of the ban on all those books that are now condemned for not using the binary specific names in their nomenclature.

In my opinion, therefore, all such ternary names, when applied to the type of the species and retained under it, should be condemned as being contrary to the binomial system of nomenclature. Though *Aglaonema angustifolium* N. E. Br., could *in sensu lato* be used to include all the subspecies and varieties described under it, *in sensu stricto* it must be applicable the Holotype and the plants represented by it: all trinomials with *A. angustifolium* as the first part being invalid for this form.

13. Nomen Dubium or Mixtum Compositum* (Arts. 52, 62–65)

When a species is to be divided into two or more species, Art. 52 of the Rules provides for the retention of the specific epithet to the type designated by the author. But in the case

* A *Taxonomic Name* must indicate only one element of its rank. A *Mixtum Compositum* is a taxonomic name which by definition covers more than one element of the same rank, or to which more than one element of the same rank has been assigned in the original description. All plants belonging to one form, or variety, or species, or genus (etc.) make, in the opinion of a botanist, one *ELEMENT* of the same rank. There are two kinds of *Mixta Composita:*

(1) NEGATIVE MIXTUM COMPOSITUM: a name whose description is so vague as to be applicable to more than one element. These may be subdivided according to their types as follows:

(*a*) types represent more than one element, but the holotype is indicated;
(*b*) types represent more than one element, but the holotype is not indicated (=*nomen dubium*);
(*c*) types are not extant (=*nomen dubium*).

(2) POSITIVE MIXTUM COMPOSITUM: either **(A)** a taxonomic name whose description includes discordant characters, each set being applicable to one element, and whose types are either

(*a*) not extant (=nomen confusum);
(*b*) or if extant, then either a holotype is not indicated (=nomen confusum); or
(*c*) a holotype is indicated.

or **(B)** a name whose description, though not containing discordant characters, agrees only partly with the indicated holotype.

If in **(1)** all syntypes represent one element, then such a taxonomic group is excluded from the category of a mixtum compositum; if in **(1)** and **(2)** the types are extant and a holotype is indicated, the Rules oblige us to interpret the name with reference to the indicated holotype, even when this type is not the one that agrees best with the description. If types are extant and do not agree with the description at all, then the probability is that some types are lost, or that the author has used a wrong terminology to describe the characters of the type specimens. It is only when the primary types are not extant, or when extant one of them is not indicated as a holotype, that the difficulties arise in interpreting satisfactorily a *mixtum compositum*. In common parlance a *mixtum compositum* means a name of any of the two classes: (2–A–*a*) and (2–A–*b*).

where the type has not been designated, regulations for choosing the lectotype have not yet been made; so that it is quite easy at present to reject a species whose syntypes represent more than one species, as a nomen confusum, dubium vel ambiguum (Arts. 62–64).

Yet if one were to apply these provision (Arts. 62–64) in every case, where a specific description was drawn from syntypes representing more than one species, I think the majority of the specific names from the time of Linnæus down to the end of the last century will have to be discarded, and a similar fate might also await several names published during the last thirty or forty years.

The usual procedure in such cases has been to retain the name for that one of the syntypes that agrees best with the description, and to exclude from the species all other specimens that do not correspond with the selected syntype (=lectotype). Should there be more than one such specimen having equal claims to be selected as the type and should they represent more than one species, the first author to choose one of them as the type must, in my opinion, be followed. This principle is also in accordance with the provisions made in Arts. 56 and 61 for selecting one name as the legitimate from a number of rival names of equal age.

If this procedure be legitimized, a large number of species having now a disputable status will become clear and stable, thereby diminishing the number of the nomina ambigua, dubia vel confusa. In fact I think that the Appendices for Nomina Ambigua and Nomina Confusa should not be prepared unless this procedure, and the one recommended for interpreting the species validated by references to invalid but effective literature (Class II), are found unworkable (which might be only in a very limited number of cases). The principle if adopted will induce also a better research into the status of old species and it will avoid a haphazard rejection of species on the basis of our ignorance.

Examples:—

(*1*) Under *Cerbera Manghas* L. (1753) Linnæus cites several entirely discordant elements which have made some botanists either reject the species as mixtum compositum, or interpret it with reference to one or other of the discordant elements that do not agree with the description. It is true that Linnæus cited several references that are not identical with the type on which the description was based; but in doing this Linnæus was keeping up the procedure of the times which, perhaps with the intention of helping the students of the local floras, made botanists include in the synonymy all the references that they not only considered as equivalent, but even suspected as approximate, synonyms. In my opinion the ambiguity or confusion has arisen on this Linnean species owing either to the failure to notice that the lengthy specific description of Linnæus was derived from Osbeck's specimen from Java, or to the imperfect acquaintance of some botanists with the genus; for it is obvious that the Linnean description is not applicable to *C. odollam* Gærtn. at all but is

exactly *C. lactaria* Ham. *ex* DC. Much harm would result if, owing to imperfect acquaintance with genera or species concerned, or owing to failure to account correctly for the type specimen, one were to reject a good species like *C. Manghas* L. as a nomen ambiguum, confusum, vel, dubium, or to conserve another name against it.

(*z*) Under *Poa amboinica* L., *Mantissa* II, 1771, p. 557, Linnæus gave a specific description which does not agree either with the plate or with the description of *Phœnix amboinica montana* Rumph. (Herb. Amboin. VI p. 19 t. 7 fig. 3), a reference given by Linnæus in the synonymy of the species. In 1786 Retzius pointed out these discrepancies and excluded the Rumphian species from *P. amboinica* L., retaining this name for a South Indian plant which was distributed under the name by Kœnig, and with which the Linnean description agreed. It is not known whether Retzius had seen the actual type specimen, or its duplicate, on which Linnæus based his description, nor does he give any reasons why he interpreted the species by reference to Kœnig's specimen. There is also no specimen in the Linnæan herbarium to decide this matter. But seeing that Retzius was a contemporary of Linnæus and Kœnig, and that Kœnig corresponded with several botanists in Europe including Linnæus and Retzius, it is not unreasonable to suppose that Retzius had clues, now lost to us, that warranted his interpretation by reference to Kœnig's specimen. Mr. C. E. C. Fischer, who inquired into this subject, also supports this conclusion. (Kew Bull. 1934 p. 398). But the absence of any obligation for botanists to follow the first botanist (in this case Retzius) who selected the lectotype or neotype of *Poa amboinica* L., has made some take the Rumphian figure as the type of the Linnean species, causing thereby instability and lack of uniformity in the nomenclature of the two species, and has made others favour the rejection of *P. amboinica* L. either as *nomen ambiguum* or *nomen confusum*.

The most difficult problem that arises in stabilizing plant nomenclature is in regard to species, the types of which are not extant and the original description of which seems to be inadequate for the correct specific identification. In such cases it is customary to identify the species by interpreting their botanical descriptions on plant-geographical considerations. But if, by such a procedure, one cannot definitely accept or reject a given interpretation of such a species, then one should be obliged to follow the earliest interpretation that is not obviously discordant with the original description. It should be prohibited to interpret the species merely on the vernacular names, and the economic uses, enumerated in the original descriptions, and to make changes accordingly in the specific nomenclature. The particulars about the vernacular names and the economic uses of a species may supply a clue to its ultimate identification on a scientific basis, but they cannot be accepted as decisive, or even as a part of the botanical description. In this field it is desirable to restrict the activities of those who rely on such means because their activities are often a source of great confusion in plant nomenclature and lead to instability in the nomenclature of the species that had otherwise definite and stable botanical names.

I enumerate here a list of principles which have proved useful to me in the interpretation of a mixtum compositum, or

a doubtful species whose types are not extant. It might be worth while to give these a trial in order to test their universal utility :

A. When a description covers more than one species or varieties (or element), *then give more importance to:*

1. the characters mentioned both in the body of the description and in the remarks than to those mentioned under the remarks only and not in the description, when under the remarks the author recognized more than one form of the species sensu lato. The probability is that the characters mentioned only in the remarks have been deliberately excluded from the body of the description because they belong to one of the subordinate groups, not to the typical form;

2. the characters mentioned in the body of the description than to those mentioned in the remarks, if the remarks refer to a form or variety different from the one described in the body (*e.g. Croton polot* Burm.f.);

3. the characters mentioned in the description than to those not mentioned in it but figured in the plate published simultaneously with the description, even though these characters have been cited in the remarks as belonging to one of the subordinate groups constituting the main group;

4. the characters recognizable by the senses of touch and vision than to those recognizable by the sense of taste and smell;

5. the characters referring to twigs, leaves, flowers and fruits than to those referring to the entire plant, and observable only in the field;

6. the characters visible in the dry state (and referring to twigs, leaves, flowers and fruits) than to those observable in the field or in the living state, except when there is a clear evidence to show that the author studied the plants in the field and not in the herbarium, in which case both sets of characters could be given an equal value (as in Blanco's *Flora de Filipinas,* Loureiro's *Flora Cochinchinensis*);

and 7. characters observable on the plant itself than those referring to its economic uses (cf. also C. 2).

B. Attach *equal importance to:*

1. the specimens cited but not figured and to those that are both cited and figured. Very often the specimens studied are not the ones that are figured; and very often, too, figures are not drawn by the

authors themselves, but by their draughtsmen. Out of these specimens choose as the lectotype the specimen that agrees best with the description;

2. the specimens cited but not figured and the specimens not cited but figured, provided there is clear evidence to show that the description covers both. (*e.g. Polypodium sessilifolium* Hk., the type of which is taken to be the specimen figured, although it was not cited; *see* Gard. Bull. S.S. IX p. 134.)

and 3. the characters observable in the field like the colour, height of the plants and the thickness of the main trunk and those observable in small specimens consisting of twigs, leaves, flowers, and fruits, provided there is a clear evidence to show that the author drew his specific description in the field and not in the herbarium.

C. *Disregard altogether* any information or particulars regarding :

1. vernacular names;

2. such economic uses as do not give any clue as to the nature, size, and colour of the plants;

and 3. any part of the plant if there is a definite evidence to show that the author derived that bit of information from others or from books and herbarium labels;

but these actions are to be taken only when the particulars on any of these points introduce the discordant element in the description, or render a decisive interpretation impossible. These particulars, if taken into account, must not be made the principal basis for rejecting an accepted interpretation of a species.

D.—(1) If a mixtum compositum (positive) covers two or more species or elements of a rank higher than that of species, then follow the earliest interpretation that takes into account all the *characters of greater importance,* even if this interpretation does not agree with the characters of lesser importance. In the interest of stability in the names of families, genera, and species, a consideration of characters of lesser importance (such as those observable in the living state only and as undergo change during drying) must not be admitted as a plea of sufficient importance for rejecting an earlier interpretation because such a rejection might affect profoundly the long accepted nomenclature of several species, genera, etc.

(2) If a mixtum compositum (positive) consists only of different varieties or of forms of lower rank than species, then accept the earliest interpretation that takes into account *both the important and the less important* botanical characters.

(3) If it is a question not of a (positive) mixtum compositum, but of an apparently indifferent description that seems applicable to more than one element, and whose types are not extant, or if extant represent more than one element, then the botanical *characters of lesser importance must also be considered,* and the earliest interpretation that fits in with all the botanical characters given in the original description and with plant geographical considerations must be accepted. A ruling to this effect might discourage interpretations of old, doubtful species without an adequate study and reason.

E. If the name of a mixtum compositum, positive or negative, has been long overlooked by botanists, or if it has been excluded as a species of doubtful affinity or as a nomen dubium, or confusum, it should not be used for any taxonomic group without adequate botanical reasons, or proofs (*vide infra*), when the adoption of such a name leads to changes in the accepted nomenclature of species and genera. The very fact that the name of a doubtful species has long been cited in the synonymy must not be taken as a reason of sufficient importance to adopt the name under the principle of priority. Such names have been frequently cited in the synonymy of a species, not because the names are identifiable, but because the authors citing them suspect them to be identical and hope the citation may form a clue to the ultimate identification of the mixta composita on botanical grounds.

NOTA: By PROOFS or ADEQUATE BOTANICAL REASONS are meant the reasons why the name must be clinched to a particular taxonomic group and not to any others, or how the description published under the name agrees with that of the taxonomic group identified with it. Thus I would consider *Mischophlœus vestiaria* (Giseke) Merrill, Interpr. Rumph. Herb. Amb. (1917) 121 and *Ormosia pinnata* (Lour.) Merr. in Lingnan Sci. Journ. XIV (1935) 12 as examples of interpretations unaccompanied by any reasons except by the writer's statement of his convictions, while that of *Cerium spicatum* Lour. and *Aidia cochinchinensis* Lour. by Moore in Journ. Bot. LXIII (1925) 250 as examples of interpretations accompanied by proofs or adequate botanical reasons.

14. Tautonyms and Homonyms

The regulations concerning tautonyms are embodied in the following extract of Art. 68 (3):

"Specific epithets are illegitimate in the following special cases and must be rejected.————(3) When they exactly repeat the generic name with or without the addition of a transcribed symbol (tautonym)————Examples————(3) *Linaria Linaria, Nasturtium Nasturtium-aquaticum.*"

From this it is evident that tautonyms come under the regulations enacted as essential for the words constituting a

specific name, and, therefore, are to be regarded as invalid names. And so far as the wording goes, this rule appears to be complete in itself, though it is not clear under what provision the binomial *Nasturtium Nasturtium-aquaticum* is to be regarded as a tautonym, unless of course *aquaticum* is considered as a symbol. But if one considers this Article in conjunction with the regulations on the orthography of names (Art. 70), there appears to be much room for equivocal interpretations.

That the reasons for asserting this may be better followed I transcribe here some parts of Art. 70 that are to the point:

"When the difference between two generic names lies in the termination, these names must be regarded as distinct, even though differing by one letter only. This does not apply to mere orthographic variants of the same name."

"Note 3: In deciding whether two or more slightly different names should be treated as distinct or as orthographic variants, the essential consideration is whether they may be confused with one another or not: if there is serious risk of confusion, they should be treated as orthographic variants. Doubtful cases should be referred to the Executive Committee."

"Note 4:————Epithets bearing the same meaning and differing only slightly in form are considered as orthographic variants. The genitive and adjectival forms of a personal name are, however, treated as different epithets (*e.g. Lysimachia Hemsleyana* and *L. Hemsleyi*)".

Further we are told that generic names like *Rubus* and *Rubia Peponium* and *Peponia, Iris* and *Iria, Gerrardina* and *Gerardiina Desmostachys* and *Desmostachya,* or *Peltophorus* and *Peltophorum* are not pairs of homonymous names. This appears surprising, because one would think that they should come under the provision made in Art. 70, Note 3, which permits one to treat a name as an orthographic variant even when a name or epithet, owing to its close similarity with another of the same rank but of different origin, is liable to be confused with the latter. Yet we are told that such words as *napaulensis, nepalensis* and *nipalensis; heteropus* and *heteropodus; Bradlea, Bradlœia, Bradleja* and *Braddleya; trinervis*(*-e*) and *trinervius*(*-a, -um*); are groups of orthographic variants. The first two groups of epithets are regarded as orthographic variants, apparently because they mean the same thing, and because they are derived from the same word, or because they refer to the same place; the third group of words because they all refer to the same person and because each of them has been spelt by subsequent authors both as *Bradleia* and *Bradleya,* and this in spite of a ruling that changes in the original spelling are not to be recognized under Art. 70; but the last one, though it has the same meaning, has two different roots and belongs to two different declensions in Latin.

If *Bradlea Braddleya* is a tautonym because the second epithet is an orthographic variant of the first, the question arises whether such combinations as *Desmostachys Desmostachya, Gerrardina Gerardiina, Chœrefolium cerefolium* L., and *Kandelia*

Candel (L.) Druce are tautonyms? The principles regulating the homonymous generic names, if applied to these cases, would admit these as valid names and not reject them as tautonyms, though under usage, and perhaps under the provision in the Note 3 of Art. 70, one would be able to reject many such names as tautonyms. Further if *Nasturtium Nasturtium-aquaticum* is a tautonym, are *Radiola Radiolaris, Leontice Leontopetaloides, Ficus syco-morus* and *Pinanga Pinangifolia* also tautonyms? If such names as *Desmostachys Desmostachya* or *Gerrardina Gerardiina* are not regarded as tautonyms, despite the provision in Art. 70, Note 3, I see no reason for outlawing such binomials as *Bradlea Braddleya,* and *Radiola Radiolaris,* or even *Radiola Radiola.*

In this matter usage, too, has been very erratic, even amongst botanists who have shown manifest adhorrence for tautonyms; for, while they readily discard as tautonyms such binomials as *Normanbya Normanbyi* (F. Muell.) L. H. Bailey (1935) and *Sullivantea Sullivantii* Britton (1894), they admit without any protests binomials like *Cuminum Cyminum* L., *Kandelia Candel* (L.) Druce (1914) and *Carum Carvi* L. (the last being also spelt as *Carum Carui.*).

Similarly the regulation pertaining to homonyms is also unsatisafctory. Article 61 defines a later homonym as a name which "duplicates a name previously and validly published for a group of the same rank based on a different type.———Note : Mere orthographic variants of the same name are treated as homonyms, when they are based on different types.—*See* Art 70."

Does this means that binomials like *Baccaurea malayana* and *B. malayensis,* or *Rhizophora Candel* L. and *R. Candellaria* DC are to be treated as two pairs of homonymous names, on the ground that they bear the same meaning and differ but very slightly in form (Art. 70, Note 4)? If trivials epithets like *Ceylanica* (from Portuguese Ceylao), *Zeylanica* (from Dutch Zeylan) and *Ceylonica* (from the English Ceylon), or like *trinervis* (third declension in Latin) and *trinervius* (second declension in Latin) are to be taken as homonymous, because they mean the same thing, are epithets like *Ceylonica, Singalensis, Singalana, Sinhalensis, Singalica, Cingalensis* and *Ceylonensis; Brownei, Brownii, Morenii* and *Brunonis; Sinica* and *Sinensis; Hispaniensis, Hispanus* and *Hispanicus; Javana, Javensis, Javanensis* and *Javanica; Aquillaria* and *Agalocha; van-der-Brœcke* and *Paludanus; Saharæ* and *Saharana* (both referring to the country Sahara); *Anamitica* and *Annamensis; Celebica, Selebica* and *Celebesiana;* to be taken as homonymous groups? These questions do not appear to have been settled by the Rules, and the examples given in the Rules do not apply to such cases. The recent usage on this point is also very contradictory.

The treatment of homonymous generic names in *Kew Bulletin* (1935) 341–544 also shows a complete absence of uniformity in the principles adopted by different contributors to the *Bulletin*, thus confirming my contention that the Rules are equivocal on the subject of homonyms and tautonyms.

Thus Prof. Alfred Rheder (Arnold Arboretum) regards *Andrzeiowskia* Reichb. (1823) and *Andreoskia* DC. (1824) as orthographic variants, because both genera were named in honour of A. Andrzeiowski. If this principle is adopted as a general rule, it would appear that the Rules do not permit naming more than one genus after the same person.

But Miss M. L. Green (Kew) considers *Wendtia* Meyen (1834) not homonymous with *Wendia* Hoffm. (1814), though the latter name was "corrected" by De Candolle to *Wendtia* in 1830, that is, four years before *Wendtia* Meyen was published, and though both *Wendtia* (1834) and *Wendia* (1814) appear to have been published in honour of the same person. Apparently Miss Green has overlooked the case of *Bradlea, Bradlœia, Bradleja* and *Braddleya* discussed in the Rules, where we are told to consider these four generic names as mere orthographic variants, not only because they commemorate the same person, but also because each of them has been spelt by subsequent authors indifferently both as *Bradleia* and as *Bradleya,* and "only one can be used without serious risk of confusion."

Further Dr. R. Mansfeld (Berlin) treats *Pentaceros* Mey (1818), spelt later as *Pentaceras* by Roem. et Schult. (1819), as if it is homonymous with *Pentaceras* Hook. f. (1862); *Pentagonia* Benth. (1844) with *Pentagonium* Schau. (1843); and *Psilanthus* Hook f. (1873) with *Psilosanthus* Neck. (1790). And yet, in the Rules, *Peponium* and *Peponia, Symphostemon* and *Symphyostemon, Elodes* and *Elodea,* are cited as examples of distinct, non-homonymous names.

Then Prof. A. Rheder is not sure whether *Augusta* Leandro (1819) and *Augustia* Klotzsch. (1854) are homonymous names, despite their different derivation, but proposes the conservation of *Augusta* Pohl (1829), also spelt later as *Augustea,* though it is a monotypic genus having a legitimable valid synonym; and without waiting for the decision of the Congress, he makes the new combination *A. longifolia* (Spreng.) Rheder, apparently in the sure belief that this proposal will be accepted by the Congress.

In contrast, Mr. C. A. Wheatherby (Gray Herbarium) considers *Conocephalus* Bl. (1825) and *Conocephalum* Wiggers (1780) as homoymous names. He strikes *Conocephalus* Necker (1790)* out of consideration, because Necker did not publish a new genus of that name, but merely changed the spelling of *Conocephalum* Wigg., which change, he maintains, is inadmissible in the Rules. (That such changes are some times admissible for the purpose of homonyms may be seen in the example of *Bradlea* and *Braddleya* discussed under the Rules). Further he says that "*Conocephalus* Bl. was unanimously employed up to 1934", when Merrill abandoned it to take up *Poikilospermum* Zippel *apud* Miq (1864). He admits that even Merrill has not examined the type of the genus *Poikilospermum,* the botanical affinity of which is yet uncertain, and that further changes will be necessary if *Poikilospermum* is segregated generically from *Conocephalus* Bl. proper. He acknowledges that "the least disturbance in nomenclature would have resulted from conserving *Conocephalus* Bl. against its earlier homonym [*Conocephalum*

* According to the view of Dr. A. J. Wilmott (Kew Bull. 1935 p. 92) *Conocephalus* NECK., being a name of NECKER's "Species Naturalis", would be an invalid name, though all NECKER's "Species Naturales" correspond to LINNEAN Genera.

Wigg]———. Since, however, the number of species concerned is not very large (about 35), it is probably better to accept Merrill's treatment of the matter." This might be paying respect to the person of Merrill, but not to any principles given in the Rules, for the Rules have expressly instructed us to take the generic names like *Peltophorus* and *Peltophorum* as different, and not homonymous, names. Besides changes in the nomenclature of thirty-five species may seem insignificant to a non-Malayn botanist, but to Malayan botanists who have been accustomed to see *Conocephalus* Bl. used in the literature of a hundred years for a group of common forest plants, changes in the names of thirty-five species are rather a big and vexatious alteration, even more than to American botanists is the rejection of the name of the monotypic genus *Augusta* Pohl (1829), the conservation of which requires a new combination (now made by Prof. Rheder), because an earlier specific epithet is available for the species than the one hitherto used under the genus.

These cases also show how arbitrary is the present procedure of conserving or rejecting the so called homonymous generic names, without having first defined precisely what a homonym is.

In view of this it is highly desirable that the regulations on this point should be clarified so as to define, if possible, both the tautonym and homonym in the same set of general rules; for, strictly speaking, a tautonym ought to be defined as a specific name in which the trivial epithet is a homonym of the generic name. If it is impossible to frame general laws which shall be applicable equally to tautonyms and to homonyms, because of some difference in the principles appertaining to them, or because of the mighty nomenclatorial changes that may result from the application of any such uniform rules to all homonyms, then it is necessary to show in the Rules how and why these principles differ, so that the student of the Rules will be able fully to appreciate the regulations and, when occasion arises, to decide for himself whether or not a certain name is a homonym or a tautonym. If any extensive changes may result from the adoption of such principles in the generic nomenclature, then it will be advisable to conserve such generic names as exceptions to be mentioned in the Rules, where they will be handy. General laws are much better for the guidance of botanists than obligations to call now and then upon the Executive Committee to give its arbitrary decisions on the matter.

If attempts are not made to clarify this situation as soon as possible, then it is to be feared that the opinion, favouring tautonyms as legitimable valid names, will soon gain ground, and we may have to witness the present regulations against tautonyms and homonyms vetoed, or at least considerably modified, by future congresses.

If general laws, that give due regard to the derivation of the words, are not possible, then artificial rules such as the zoologists have, will be better adapted to the needs of systematists so that, apart from the generic names which, to prevent extensive changes, may require different rules, specific epithets, even of

different origin, may be considered as homonymous if they resemble each other very much, at least in the main part of the word. Besides now that the Rules do not acknowledge misapplications and miscitations as validly-published new binomials as was done formerly, there is no need to attach any great importance to the derivation and meaning of the words, provided serious risks of confusing one name with another are avoided and a uniformity in the rules is secured. Thus if *Gerardiina* and *Gerrardina* are not homonymous, there is no reason why *Bradlea* and *Braddleya* should be.

For this purpose the following groups of letters might be considered as equivalent:

(*A*) Terminations of generic, tribal, or sectional names: *a* = *ie* = *ea* = *eya*; *us* = *yus* = *ys* = *is* = *es* = *os*; *um* = *on* = *oon*.

(*B*) Terminations of epithets of species and of groups below the rank of species: *os* = *us* (*-a, -um*) = *ius* (*-ia, -ium*) = *is* (*-e*) = *yus* (*-ya, -yum*) = *ys* = *es* = *on* = *eia* = *eya* = *ea* = *aea*; *i* = *ii* = *yi* = *ei*;

(*C*) Letters standing in the middle of the epithets denoting genera, sections, tribes, species, varieties, etc.: *o* = *a*; *es* = *us*; *v* or *w* (as vowels) = *u*; *g* = *gh* = *gu*; *c* = *cc* = *ck* = *k* = *kk* = *ch* (hard); *c* (followed by *i, e, y, ae, oe*, except when *ae* is the genitive of the words ending in *a*, in which case *c* is hard) = *z* = *s* = *ch* (soft) = *ss*; *d* = *dd* = *dh*; *p* = *pp*; *t* = *tt* = *th* = *ct*; *ph* = *pf* = *f* = *ff* = *v* = *w* (when *v* and *w* as consonants); *m* = *mm*; *n* = *nn* = *nh* = *m* (before *b, p, m*, or *n*); *r* = *rr* = *rh*; *l* = *ll* = *lh*; *wski* (Polish) = *wiski*; *drze* = *dreze*; *ae* = *oe* = *ue* = *oy* = *ey* = *e* = *ii* = *i* = *j* = *y* = *yi* = *ei* = *iae* = *eae* (except when *ae* is the genetive of words ending in *ca, ga*, and *ka*, or is followed by *i*).

(*D*) Letters standing at the beginning or in the first syllable of the epithets or names of genera, sections, tribes, species, varieties, etc.:

(1) value of the consonants given in (*C*);

(2) *e* = *ae* = *oe*; *i* = *y*;

(3) a vowel preceded by *h* is equivalent to the vowel without the preceding *h*.

For the purposes of generic homonyms, the rules of terminations of the generic names and those for the middle and the beginning of the words (*i.e. A, C* and *D*) should be taken into account: while for the purpose of tautonyms, and homonyms of specific names and of names below the rank of species the regulation for the terminations of the specific epithets and for

the valency of letters occurring in the middle and at the beginning of the words should be taken into account. If it is desirable to regard such epithets as *malayana* and *malayensis; javana, javensis, javanensis* and *javanica; philippensis, philippinensis* and *philippina; timoriensis* and *timorensis;* or *anamiticum* and *annamense,* as homonymous, a paragraph could be added making adjectives ending in (*a*) *nus* (*-a, -um*) = *ianus* (*-a, -um*) = i (*n*) *ensis* (*-e*) = *ensis* (*-e*) = (*it*) *icus* (*-a, -um*) as homonymous.

This rule would make *Gerrardina* and *Gerardiina,* or *Anadendron* and *Anodendrum,* as pairs of homonyms; but not *Chonemorpha* and *Conomorpha;* but if it is desirable to keep the first two pairs as distinct, then they could be included as nomina generica conservanda, or as exceptions to the general rules.

As an extreme case, tautonyms might be defined as a specific name in which the specific epithet either is homonymous with the generic name (*Radiola Radiola*), or is an adjective or genitive (masculine or feminine) derived from it or its root (*Normanbya Normanbyi, Radiola Radiolaris*), or is itself the root of the generic name (*Kandelia Candel*), or still is the generic name with another word or particle added, with or without the change of the terminal ending of the generic name (*Nasturtium Nasturtium-aquaticum; Pinanga Pinangifolia; Pinanga pinangioides. Araucaria araucana*).

However it would be undesirable to put a ban on all such names. I think tautonym-phobes would be satisfied if only absolute tautonyms were invalidated, by defining absolute tautonyms as specific names where the trivial epithet, or its root, is homonymous with the generic name, or its root. This would outlaw all such names as *Normanbya Normanbyi, Carum Carui* L., *Chaerefolium cerefolium* L., and *Radiola Radiola* L., but not *Volvaria volvacea, Kandelia Candel, Nasturtium Nasturtium-aquaticum, Radiola Radiolaris, Cuminum Cyminum* L., and *Brownea Brunonis.*

It may be observed here that zoologists have already removed the ban on tautonyms, even on absolute ones, and that the admission of absolute tautonyms as legitimable valid names would simplify much the procedure prescribed for new combinations.

15. Linnean Genera (Arts. 20 and 42)

Art. 20 has the following note on the genera in Linnæus's *Species Plantarum:*

"It is agreed to associate generic names which appear in Linnæus's *Species Plantarum* ed. 1 (1753) and ed. 2 (1762–63) with the first subsequent descriptions given under those names in Linnæus's *Genera Plantarum,* ed. 5 (1754) and ed. 6 (1764)".

From this one might conclude that, though the two editions of the *Genera Plantarum* are respectively later than the two first editions of the *Species Plantarum,* the ed. 5th and ed. 6th of the *Genera Plantarum,* are to be regarded for the purposes of Arts.

41 and 42, as having been published simultaneously with the two editions of the *Species Plantarum*, and that the genera described in the 5th edition of the *Genera Plantarum* are to be given precedence over those in the 6th edition. Since, except in the case of *descriptio generico-specifica* (Art. 43), a genus is not validated by a description or mention of the included species (Art. 41), this would also mean that a generic name like *Cycas* used in the two editions of the *Species Plantarum*, but not described in either of the two editions of the *Genera Plantarum*, will have to be regarded as invalid.

But from the note made in Art. 42 this does not appear to be the intention of the legislators. The note runs as follows:

"An exception is made for the generic names published by Linnæus in *Species Plantarum* ed. 1 (1753) and ed. 2 (1762–63), which are treated as having been validly published on these dates."

This would mean that Linnæus's genera in *Species Plantarum* ed. 1 and 2, have to be interpreted with regard to the species described in those two books, in which case the generic descriptions in *Genera Plantarum* ed. 5 and 6 could be taken as giving only clues to the correct interpretation of the genera. Should there be a divergence between the descriptions given in the Genera Plantarum and those indicated by the species or by the lectotype species adopted under the Rules, then the descriptions of the species should alone be taken as decisive, no changes in the conception of the Linnean genera or in the lectotype species being allowable on the basis of the Linnean generic descriptions.

16. Orthography of Names (Rec. XLIII)

This note is provoked by the following remarks made by Dr. A. B. Rendle in the review of the late Dr. A. S. Hitchcock's *Manual of the Grasses of the United States:* "And why does Dr. Hitchcock who is a leading supporter in America of the International Rules of the Botanical Nomenclature, desecrate personal trivial names with a small letter?" (*Journ. Bot.* LXXIV, 1936, p. 29).

In the first place the regulation regarding the use of a capital letter for personal trivial names is embodied not in a Rule but in a Recommendation, so that the use is not an obligation. The recommendation reads as follows:—

"Specific (or other) epithets should be written with a small initial letter, except those which are derived from names of persons (substantives or adjectives) or are taken from generic names (substantives or adjectives). Examples: *Ficus indica,*———— *Lythrum Hyssopifolia, Brassica Napus,*————".

At first the recommendation seems very simple; yet on a closer examination it will be found that the recommendation, besides being very illogical, is also extremely difficult to follow.

Logically one cannot write *Napus* in *Brassica Napus* L., *Hyssopifolia* in *Lythrum Hyssopifolia* L., and *Radiola* in *Linum*

Radiola L. (the last is mentioned in the example under Art. 69 of the Rules) with initial capital letter because all the species concerned are Linnæus's, who did not use any of these names for a genus. They were raised to the generic status long after Linnæus: *Napus* in 1829, *Hyssopifolia* in 1852, and *Radiola* in 1788. They may have been used as generic names before Linnæus, but under the Rules such names are invalid. If made valid especially for the purpose of following this recommendation, then practically all vernacular names, deprived of their qualifying adjectives, would also become valid for the purpose, because they are also generic names, though not in the Linnean sense. In fact, Linnæus wrote with the capital letter all vernacular names used as trivial epithets, but in the Rules such names are printed with a small letter, *e.g. Gluta Renghas* L. in Art. 70.*

But even when cases like those mentioned above are excluded, the Recommendation is still difficult to follow. The specific name say *Victoria* or *Victoriana* has, according to this recommendation, to be spelt with a capital letter, if it refers to the Queen or a lady named Victoria, and with a small letter if it refers to a place. This means that a botanist who wishes to follow this recommendation faithfully, will have to waste a good deal of his time in looking up the original references, and even then he might find the matter not easy to decide upon, because in the original reference the derivation of the name is not clearly stated. A rather lengthy list might be made of such names as are applicable at the same time equally to persons and to places.

Then a doubt arises whether such names as *Princei, Connaughtii,* etc. should be spelt with a capital when they are taken not from personal names but from titles *e.g.* Prince Albert, Duke of Connaught, etc. Further why should the supporters of the recommendation not begin with a capital letter such names as *van-Steenisii, van-Houtteana, von-Muelleri,* etc.; and again why include a capital in the middle of such names as *MacArthurii, MacDonaldiana,* etc.? Under the recommendation *Van-steenisii, Van-houtteana, Von-muelleri, Macarthurii, Macdonaldiana,* etc. (with or without the middle dashes) should be the correct latinized epithets.

All this shows that the recommendation is contrary to the spirit of the Rules which contains the following remarks in Art. 2:

"The recommendations deal with subsidiary points, their object being to bring about *greater uniformity and clearness* in future nomenclature: names or forms contrary to a recommendation cannot on that account be rejected, but they are not examples to be followed". (italics are mine).

Hence this recommendation, which proposes to introduce into the Rules an element of illogical diversity, and of arbitrari-

* New amendments recommend the use of capitals for epithets derived from vernacular names also, but do not consider the faults in Rec. XLIII.

ness, at the sacrifice of simplicity and uniformity, should not have been adopted by the legislators even as a Recommendation.

No wonder, therefore, that such staunch supporters of the Rules as the late Dr. Hitchcock are found to disregard the recommendation for the adoption of a capital letter for certain trivial names and to use a small letter uniformly for all, a procedure that has also the approval of practically all non-botanical systematists, and that is being logically followed by the majority of American botanists.

17. Validating a Name by Referring to a Misapplication

There are cases where botanists have looked upon misinterpretations of a species as constituting valid but illegitimate homonyms. This faulty view has apparently had its genesis at a time when the type-basis concept was not generally accepted, while the faulty way of referring to a misapplication has been mainly responsible for making it widely current amount botanists and for obscuring the actual difference between a misapplied name and a homonym.

But now that the type-basis concept has been made obligatory in modern plant-nomenclature, there is no reason whatsoever why misapplications should be confused with homonyms, even in the manner of referring to them in literature. Thus to cite *Tsuga Mertensiana* (Bong.) Sarg. for *T. Mertensiana* (Bong.) Carr. *sec.* or *emend* Sarg., or *T. Mertensiana* Carr. for the misapplication Carrière made in transferring *Pinus Mertensiana* Bong. to the genus *Tsuga,* has been declared irregular by the last Congress (1935).

Fortunately, however, whenever a misinterpreted specimen has been found to be a new species, botanists holding the erroneous view have not tried to validate the new species by merely referring to the misapplication; but in every case I have seen they have included at least either a valid description for their new species or a reference to a validable figure.* Were it not for the description, or the reference to the figure, the new binomial would have been a nomen nudum, even if the references to misinterpretations contained descriptions applicable to new species; for all misapplied descriptions, however detailed, are intended by their author to be nothing but complementary or

* After writing the above, I came across Rendle's "*Gonolobus jamaicensis* nom. nov." (Journ. Bot. LXXIV, Dec. 1936, p. 345) which is a *nomen nudum,* as it is based on the misapplication *G. rostratus* (Vahl) Roem. et Schult. by Schlechter (Urb. Symb. I, p. 284), i.e. on *G. rostratus* (Vahl) Roem. et Schult. *sensu* Schlechter *partim,* excl. specimen typicum. Rendle himself has not given any description of the species, nor has he referred to any validable description or plate, though he has indicated the type. A name accompanied by an indication of the type but not by a description or by a validable reference, is not admitted as valid under the Rules, *e.g.* several names in Wallich's *Catalogue.*

supplementary to the existing descriptions of their misapplied name, and therefore they do not change the type of the misinterpreted species, nor even do they succeed in changing the status of the misapplied name so as to make it a new homonym. All that these misinterpretations do is to mislead some botanists as to the exact identity, and the range of distribution, of the species.

Since a misinterpretation creates neither a new name, nor a new type, that can be called its own, it cannot be called a homonym, which has both a name and a type of its own. And since, according to the type-basis concept, no one is obliged to consider the specimens wrongly cited under a species, even when these specimens have formed the basis of a detailed misinterpreted description, it follows that one is not bound to look up references to misinterpretations or to miscited specimens, unless the misdetermined specimens or figures are made the types of an original description of a new species. In the latter case it is not the reference to a misinterpretation, but the fresh description given of the specimen or the figure under the new specific name, that transforms the specimen or the figure into the type, irrespective of any amount of references to its previous misinterpretations or miscitations. Similarly in the case of a validable figure, it is the reference directly to it, rather than to any of its previous misinterpretations, that validates the description of a new species and makes the figure the type of the species.

Thus *Calophyllum Jacquinii* Fawcett et Rendle (Fl. Jam. V, 1926, p. 200) is validated not by references given under it to the various misinterpretations of *C. Calaba* L. *sensu* Jacq. (Sel. Stirp. Amer. 1763, p. 269), but by the several plates quoted under it and by the original description given by the authors. It is right in this case to consider *C. Jacquinii* not as nomen novum (as regarded by the authors) but as a species nova, and therefore to look upon all the specimens cited by the authors as its syntypes. Had *C. Calaba* in Jacquin's work (Sel. Stirp. Amer. 1763, p. 269) been a later homonym of *C. Calaba* L. (1753), then *C. Jacquinii* Fawc. et Rendl. would have been a new name so that its syntypes would have consisted of the syntypes of Jacquin's species only, and not any other plate or specimens cited by Fawcett and Rendle.

However *Clerodendron nutans* Wall. *ex* Don, Prodr. Fl. Nepal (1825) 103 and *C. nutans* Wall. *apud* Hook. in Bot. Mag. (1831) t. 3049 are to be regarded not as two different misinterpretations, but as two different homonyms, of *C. nutans* Wall. *ex* Jack in Malay. Misc. I, part 1 (1820) 17, for they were all published independently of each other. It is true that in each case the author tried to interpret Wallich's manuscript species, but manuscript species and manuscript types have no status in modern systematic botany so that a botanist, who wishes to validate a manuscript species, is free to choose any type he pleases. Hence the type of *C. nutans* Jack (1820) [I prefer this formula to *C. nutans* Wall. *ex* Jack, which is recommended under the Rules] is a Penang specimen that was not seen by Wallich, that of *C. nutans* Don (1825) is a specimen from Wallich's collection from Assam studied by Don, and of *C. nutans* Wall. (1831) is Wallich's specimen described in Bot. Mag. t. 3049 which might be one of the specimens listed in Wallich's Catalogue no. 1793 [The specimen figured in the plate is different and was not seen by Wallich]. It might be noted here that *C. Jackianum* Wall., Cat. (1828) n. 1794

is an absolute synonym of *C. nutans* Jack (1820), although Wallich intended to apply that name to a species represented by a specimen he had collected in 1822 in Penang and distributed under n. 1794. This specimen cannot be included as a syntype of *C. Jackianum* Wall. because the binomial was validated by citing *C. nutans* Jack. as its basinym.

If, on the other hand, this way of reasoning is not accepted and it is allowed to validate a new species by referring to a case of a misinterpretation or misapplication without the type specimen and the type description of the misinterpreted species, then it would follow that one could validly publish by citation more than one new binomial by referring not only to more than one misinterpretation of a single species, but also to different elements originally included under one and the same species.

Thus supposing two different elements were included in *Pinus Mertensiana* Bong., one of them would be the type (=lectotype) of the species and the other a case of simultaneous misapplication of the name. One new binomial, *Tsuga Mertensiana* (Bong.) Carr., would be valid by citing its basinym, *P. Mertensiana* Bong. quoad specimen lectotypicum, and the other, say *T. Bongardii* nom. nov., by quoting its basinym, *P. Mertensiana* Bong. excl. specimen lectotypicum. This means that compilers of such works as *Index Kewensis* would have to list every single case of misapplication because it would in effect be equivalent to a homonym, thus defeating the very purpose for which the works came into existence. Herbaria all the world over would also be burdened with the responsibility of bestowing as much care on the miscited specimens as they bestow on the type specimens.

It must be noted here also that misinterpretations come neither under the category of such names as are accompanied with valid descriptions but are invalid because of some faults in their names [cf. Invalid species of Class III (1–3)], nor under the category of the species which, though recognized as new and accompanied with valid descriptions, are published without any name of their own (cf. Class IV). Taxonomic groups of the latter categories (nameless or with invalid names) differ from misapplications in that they are published as new and are accompanied with valid descriptions which are based on their own types, and, unlike misapplications, are not attributed to earlier valid names. Had such groups been given each a validable name, then the name would have been accepted as valid in botanical nomenclature. Long usage, and also the new Rules, has made it possible to validate names by referring to the descriptions of the taxonomic groups of these two classes. Thus *Arenga Griffithii* Seeman (Pop. Hist. Palms, 1856, p. 61) has been validated by a reference to a valid description published without any name by Griffith in Palms of British India, 1850. p. 168. (*See* also Section 19).

18. Citation of Misapplications of Names

The current practice of citing misapplications of names or cases of misinterpreted species is very unsatisfactory. It makes no distinction whatsoever between a misapplication and a true synonym or a homonym. Despite the lively discussion reported to have occurred at the last botanical Congress (1935) on the necessity of adopting a clear procedure for citing misapplications, the point was unfortunately left undecided. Some think that misapplications are better left out altogether from the synonymy of a species, and a proposal to that effect was even suggested at the last Congress. The principal reason for adopting this attitude by some botanists is, I think, that they find the present way of citing misapplications very vexatious and misleading, and also because no good way has so far been suggested for distinguishing between actual synonyms and misapplications. And yet references to misapplications are very necessary to show how the views of one botanist differ from another, especially in the case of misapplications which, owing to the great influence of the botanist who first misapplied them, have become widely current among systematists in general. In view of this I take this opportunity to make some suggestions on the matter, or rather to defend the procedure I have been following for some time.

During the discussion at the last Congress, it was pointed out that to cite "*Pinus inops* Ait. *sensu* Bongard; non Ait." would seem "sheer nonsense", since a species cannot be Aiton's and not Aiton's at the same time. But in my view to cite "*Pinus inops* Ait. *sensu* Bongard" leaving out the misleading phrase "non Ait.", would make sense, since it would mean that Aiton's binomial *Pinus inops* was taken in a different sense, misapplied or wrongly interpreted by Bongard. As the Rules have expressly recommended the use of such particles as *ex, in, apud* and *secundum* in order to show clearly the authorship or the interpretation of certain species, I do not see any reason why the use of *sensu* should be condemned in citations which, without its use, would cause much trouble and nuisance to botanists. The following two examples will illustrate my view on the matter:

(1) *Hedyotis monocephala* Hook. f., Fl. Brit. Ind. III (1880) 63, non Miq.

(2) *Hedyotis connata* Merr., Enum. Philipp. Pl. III (1923) 496, non Hook. f.

At first sight the reader might assume that both these binomials are later homonyms, and, therefore, they are to be rejected; but this interpretation is true only in the first case, the second being an example of a misapplication. To avoid such a conclusion, or to save the reader the trouble of consulting the original references in order to find out what the author actually means by his citations, I adopt the above manner for citing only

homonymous names, using *sensu* to indicate misapplications. Thus :

"*Hedyotis monocephala* Hook. f., Fl. Brit. Ind. III (1880) 63, non (or nec, haud, not, etc.) Miq."

would mean that Miquel and Hooker are separately authors of two different species, but both bearing the same name. If a botanist wishes to say that Hooker's species is a later homonym, he has only to add the year (1869) after Miq., and any reader would at once understand what is meant. Similarly if Miquel's name had been neglected by botanists in favour of Hooker's and one wanted to emphasize the fact that legitimately Hooker's binomial had no precedence over Miquel's, it could be done thus :

"*H monocephala* Miq., Ann. Mus. Bot. Lugd. Bat. IV (1869) 225, non Hook. f. (1880)".

I cite a misapplication thus :

"*Hedyotis connata* Hook. f. *sensu* Merr., Enum. Philipp. Fl. Pl. III (1923) 496".

while I would have cited the species as :

"*H. connata* Hook. f., Fl. Brit. Ind. III (1880) 62, non *sensu* Merrill (1923)".

if I considered Merill's interpretation as erroneous but widely accepted and, therefore, wanted to warn the reader against following it. In practice, however, the last procedure need not be used unless the references have to be very limited. Where there is some latitude for giving references, once can always exclude a misapplication by showing what portion is excluded from, or included in, it, thus :

"*Hedyotis connata* Hook. f., Fl. Brit. Ind. III (1880) 62 ; Merr., Enum. Philipp. Pl. III (1923) 496 quoad specimen Wallichianum" or "excl. specimina malesiana".

But in the case of misapplications where the type specimens are to be excluded, the use of the word *sensu* in the manner indicated above makes the statement both concise and explicit.

However this is not the only way of citing misapplications clearly; and other ways may occur to readers. But such formulæ as

Hedyotis connata (vix Hook. f.) Merr., Enum. Philipp. Pl. III (1923) 496.

and

Hedyotis connata Merr., l. c. p. 496, vix Hook. f.

are not recommendable, as they are also confusing like the previous ones discussed above. (*See* also Section 19).

19. Nomenclatorial Expressions

The argument of the preceding sections 17 and 18 rests on the principle that a taxonomic name is a nomenclatorial expression the meaning of which is not self-evident. Taxonomists therefore must agree upon the way in which a nomenclatorial expression is to be expounded, *i.e.* its denotation and its

connotation, in order to prevent ambiguity. A nomenclatorial expression should, in fact, have the exact significance of an algebraic expression. But however obvious this principle may be and however explicit the Recommendations in the Rules, the fact remains that the same class of nomenclatorial expression may carry a different meaning not only in the works of different botanists but in the works of the same botanist.

The meaning of a nomenclatorial expression is dual: it denotes a certain kind of plant, and it connotes the class of the expression and its author, and/or the opinion of one or more botanists. The denotation has recently been fixed by adoption of the type-concept. It is the connotation that is uncertain and, if this is not remedied, there will be great confusion. The following example will explain the point:

The taxonomic name *Podocarpus javanicus* Merrill is a nomenclatorial expression of the binomial class at the first intent. Therefore it should connote that that species of *Podocarpus* was first described or validly instated by Merrill. But such an expression is also used to connote:

(*a*) a binomial of the second intent, that is, one that has been transferred from one genus to another, *e.g.* *Agathis alba* Foxworthy (=*Dammara alba* Lam.), *Artocarpus champeden* Spreng (=*Polyphema champeden* Lour.).

(*b*) a misidentification or misinterpretation of the species of one author by another, the name of the second author being attached to the binomial of the first, *e.g.* *Hedyotis connata* Merr. is a misinterpretation by Merrill of *H. connata* Hook. f.

(*c*) an interpretation of the species of one author by another whether rightly or wrongly, with or without proof, but in the absence of exact denotation by a type specimen, *e.g.* *Bridelia monoica* Merr. is Merrill's interpretation of *Cluytia monoica* Lour.; *Calamus usitatus* Merr. and *C. usitatus* Becc, are respectively Merrill's and Beccari's interpretations of *C. usitatus* Blanco.

All these three uses are common. Uses *b* and *c* mean that one is permitted to make any number of homonyms on a basinym according to the number of botanists who have made wrong identifications, or different interpretations, of the original species; yet all these homonyms are invalid.

Actually *Podocarpus javanicus* Merrill connotes a misidentification of *Podocarpus javanicus* (Burm. f.) Merr., which is a binomial of the second intent based on *Thuya javanica* Burm. f. and identified by Merrill with *Podocarpus imbricatus* Bl.

I consider that the more usual nomenclatorial expressions should have the meaning I give below. These expressions may be subdivided into two main classes: (*A*) Expressions that denote a taxonomic group and connote the class of the taxonomic name, and the author who first described it; and (*B*) Expressions that, in addition to the previous meaning, connote either an interpretation given to the name, subsequent to the original description, and the author of this interpretation; or the specimens that have to be retained or excluded under the later interpretations. Under (*C*) I have included both those expressions which connote the person through whose offices an author secured the validation of his expression, and his description of it, and those expressions which I consider misleading.

The expressions of the class (*A*), though they need not indicate the type, must be interpreted according to the type, even when there are grave errors in the description given and in the specimens cited. If no type has been designated in the original description, or if it is not extant, then the species must be typified and the errors excluded (*see* Section 13). Expressions of the class (*B*), referring to errors in description or citation, cannot constitute a valid description or a valid name, because a name or a description with its type excluded is inadmissible in botanical nomenclature. In fact the use of nomenclatorial expressions to indicate errors and exclude types seems to be an anomaly, but since they serve a useful purpose in showing the portions excluded from a mixtum compositum and those retained as the lectotype, I think no harm is done by retaining their conventional use in botanical nomenclature, provided any chance of their being confused with other expressions is elimated. However it must be understood that, since such names indicate errors in description or citation, they cannot be used for validating a new name or a new nomenclatorial expression (*see* Section 17).

Class A:

1. *Juniperus silvestris* Roe denotes a certain species of plant and connotes a new taxonomic binomial described by Roe. Here the type is the specimen or the plant studied by Roe.

2. *Thuya silvestris* (Roe) Doe denotes the same species, and connotes two ideas, namely, a taxonomic name originally published by Roe, but later transferred to another genus by Doe. The type here is the specimen or plant studied by Roe.

3. *Thuya silvestris* Doe denotes a certain species described by Doe and connotes that the new name was given to the species by Doe. Here the type is the specimen or plant studied by Doe.

Class B:

1. If *J. silvestris* Roe was a mixtum compositum (positive), the resolution of the species into various components, or the

subsequent correction of it by other authors, may be indicated thus :

(*a*) *J. silvestris* Roe *quoad specimen lectotypicum* = *J. silvestris* Roe *emend.* Doe = *J. silvestris* Roe *sensu restricto* = *J. silvestris* Roe.

(*b*) *J. silvestris* Roe *excl. specimen lectotypicum* is merely a conventional expression to indicate the element that had introduced errors in the original description and citation of the species. It has no valid taxonomic or nomenclatorial status.

2. If *J. silvestris* Roe was not a mixtum compositum, but had been subsequently misinterpreted by Doe, then

J. silvestris Roe *sec.* or *sensu* Doe = *J. silvestris* Roe *quoad interpretationem Doeanam et excl. typum.*

A description given by Doe, cannot be considered as valid in taxonomic botany because, according to the type-basis concept, a description must be interpreted by its types, and the very fact that Doe gave his description under *J. silvestris* Roe means that he tacitly admitted Roe's type as the type of his description. The above expression therefore indicates the errors that were introduced by Doe, and so a new name cannot be validated merely by referring to *J. silvestris* Roe *sensu* Doe. (*See* also Section 17).

3. If *J. silvestris* Roe *emend.* Doe was the basinym of *Thuya silvestris* (Roe) Doe, then this fact may be expressed thus :

Thuya silvestris (Roe *emend.* Doe) Doe.

4. If this emendation was done by Doe after he had made the combination and not previously or simultaneously, then the expression to indicate this fact is

T. silvestris (Roe) Doe *emend.* Doe (= *T. silvestris* (Roe) Doe *quoad specimen lectotypicum.*).

5. If Doe, in transferring *J. silvestris* Roe to *Thuya,* had misinterpreted it, then according to the Rules, *T. silvestris* (Roe) Doe must be interpreted according to the type of its basinym *J. silvestris* Roe. The elements of this misinterpretation can be resolved thus :

(*a*) *T. silvestris* (Roe) Doe *sensu typico, originali* or *basynimico* = *T. silvestris* (Roe) Doe *quoad basinym* = *T. silvestris* (Roe) Doe = *J. silvestris* Roe.

(*b*) *T. silvestris* (Roe) Doe *excl. basinym* = *T. silvestris* (Roe) Doe *pro parte non-typica,* non *J. silvestris* Roe.

The latter has no valid status in taxonomic botany.

6. If *Juniperus silvestris* Roe is a polymorphous species, then

(*a*) *J. silvestris* Roe *sensu stricto* = the type form.

(*b*) *J. silvestris* Roe *sensu lato* = both the type and other forms.

7. If *J. silvestris* Roe was a negative mixtum compositum, and if one were to follow Doe's interpretation of it, without being sure whether or not Doe had made any good case for his interpretation, then this idea could be expressed thus:

J. silvestris Roe *teste/fide* Doe.

Class C:

Other expressions used by authors, or recommended or prescribed in the Rules.

1. ILEX (Tournefort) Linn. is a misleading expression for ILEX Linn., though the former is according to the Recommendation XXXII. Here the genus need not be interpreted with reference to Tournefort's genus at all, the latter being pre-Linnean and invalid. ILEX Linn. must be interpreted after the plant studied by Linnaeus and not Tournefort.

2. *Scindapsus argyræus* Hort. *ex* Engler is a misleading expression for *S. argyræus* Engler, as the application of the name by Engler may prove to be quite different from one that was current among the horticulturists of the time. The former expression is prescribed in the Rules (Art. 48), though the latter is also permitted.

3. *Clerodendron nutans* Wall. *ex* Jack is a misleading expression for *C. nutans* Jack. It is true that Jack adopted the name given by Wallich to plants in herbarium or in the garden, but the plant to which Jack reserved the name might be different from the one to which Wallich had given it. Here the type is the specimen studied by Jack and not the one studied by Wallich. The first expression is prescribed in Art. 48 of the Rules, though the second one is allowed whenever an abbreviated form is desired.

4. *Anodendron manubriatum* (Wall.) Merrill is a misleading expression for *A. manubriatum* [Wall. ms. nomen nudum] Merrill = *A. manubriatum* Merrill. The first two expressions seem to be the natural extension of the procedure of the Recomm. XXXII, though the third is the correct expression for the plant. The type is the plant studied by Merrill and not one studied by Wallich.

5. *Clerodendron nutans* Wall. *in* Don means that the name and the description of Wallich was published in a work or a paper edited by Don. If the author of the nomenclatorial expression is the same as the editor, then omit both the word *in* and the editor's name. But this *in* cannot be omitted if the work

edited by Don is a periodical, though often in such cases the editor's name may be omitted. (*vide infra*).

6. *Clerodendron nutans* Wall. *apud* Don means that Wallich is the author of the name and the description published in a monograph, or a revision, prepared by Don. Don may have concurred with Wallich's opinion and therefore allowed Wallich the credit of his work; but still Wallich alone must be considered as the author of the species. If Don had also added some citations to the ones given by Wallich, they must be excluded from the consideration in typifying the species.

N.B.—The use of these two words *in* and *apud* is not very clearly stated in Art. 48 of the Rules. Thus in the case of *Viburnum ternatum* Rehder in Sargent, *Trees and Shrubs* II (1907) 37, Sargent is considered as a part of the title of the book, whereas from the treatment it appears to be the name of the author, or of the general editor, of the book, Rehder being a contributor to the work. The following three examples will illustrate the distinction I have made above: (*a*) *Iguanura brevipes* Hook. f. *apud* Beccari et Hook. f., Palmeæ *in* Hook. f., Flor. Brit. Ind. VI (1892) 416, or merely *I. brevipes* Hook. f., Flor. Brit. Ind. VI (1892) 416. (*b*) *Iguanura parvula* Becc. *apud* Becc. et Hook. f., Palmeæ *in* Hook. f., Flor. Brit. Ind. VI (1892) 417 or *I. parvula* Becc. *in* Hook. f., Flor. Brit. Ind. VI (1892) 417, (*c*) *Globba Gibbsiæ* Ridl. *in* Gibbs, Contrib. Flor. Mount Kinabalu *in* Journ. Linn. Soc., Bot. XLII (1914) 162, or *G. Gibbsiæ* Ridl. *in* Journ. Linn. Soc., Bot. XLII (1914) 162.

20. Nomina Specifica Conservanda

The enforcement of the priority principle and the type-basis concept is causing radical changes in the popular nomenclature of some plants. But this is inevitable since certain adjustments have to be effected so that, in order to conform with the Rules, all misapplications and all illegitimate names may be rejected without any regard to the influence and position of the botanists who put these misinterpretations and illegitimate names in circulation. In complying with these provisions we support the laws that have been made with the express purpose of bringing about ultimate simplicity, uniformity and definiteness in plant nomenclature.

But time is needed in order to discover all misapplications and illegitimate names; and to do this work satisfactorily a thorough research in the types and also a monographic revision of the plants concerned, not in regard to one small region, but of the entire area where they and their allies occur have to be undertaken so that one and the same species may not receive different names in different regions or political countries. It is natural, therefore, that a work of such vastness is not to be done haphazardly, nor by one or a few botanists. Normally the more

botanists work and try to specialize in families and genera in co-operation with field workers and plant collectors, the shorter will be the time to reach the goal envisaged by the enforcement of the two principles mentioned above.

There are several cases yet to be investigated of the nature of *Raphidophora silvestris* (Bl) Engl., *R. Wrayi* Hook. f., and *R. nigrescens* Ridl. mentioned above (p. 234), where the species, which in the three different regions passed as three different species, are actually only one. In this case the botanists and others concerned in two of the countries will have to adapt themselves to the changes in the nomenclature of the species, despite the popularity of the rejected names. Then there are cases where opinions are not agreed over the identity of species or over the limits of taxonomic groups. In such cases it is but natural that the legitimate name of one botanist should become illegitimate for another. To prevent such oscillations in names is impossible unless legislation is passed fixing the limits of the taxonomic groups concerned and preventing any difference of opinions on the matter. Such a legislation is not within the province of the nomenclature laws which, being concerned only with the names, leave the delimitation of taxonomic groups to the judgement of the individual botanist; and, if actually passed, it would be tantamount to forcing the taxonomic opinions of one set of botanists on another and to hindering the progress of the taxonomic science.

And yet in a Memorandum submitted at the last Congress supporting a proposal for nomina specifica conservanda we read many unjust criticisms against unavoidable changes and against systematists in general, as if systematists effect these changes out of sheer pleasure. The criticisms also reveal a misapprehension as to the actual state of affairs.

One critic for instance, writes: "Foresters greatly resent the changing of names of well-known forest trees without any reference to the persons mostly concerned" as if the correct application of a name depended upon the views of some particular persons using the names. Another says: "Practically all the evidence of priority must have been ferretted out by botanists by now, and if some obscure references do turn up in future, there should be some limitation". This may be true in some few cases only, especially in case of the native flora of some parts of Europe where systematic studies have been carried on very intensively for a number of generations by botanists who had opportunities to study not only the plants in the field but also the types in the herbarium; but this is not so in the great majority of cases. Besides, the priority principle and type-basis concept have been very recently adopted by botanists and so an intensive study is necessary before all misapplications and synonyms can

be detected. No doubt legitimate nomenclature changes will cause some troubles at present, but in the end the procedure, when worked out in full, is expected to result in stable nomenclature except in species where the status might remain still a matter of taxonomic opinion.

But some people are impatient, and it is this impatience, coupled with inadequate understanding of the results expected from the adoption of the priority principle and type-basis concept, and with the lack of precision in some articles of the Rules, that is, in my opinion, the pricipal reason why some people clamour for nomina specifica conservanda. In fact we read in the Memorandum referred to above that the Inspector-General of Forests to the Government of India has stated the following: "If these motions are not passed I shall have to consider the appointment of a committee to deal with nomina specifica conservanda as far as Indian forestry is concerned, irrespective of what names European botanists may give to our trees".

It is to be feared that, if such a committee ever gets to work in India without any reference to European herbaria where most of the types of Indian plants are preserved, many misapplications will be perpetuated; and, if this is done without any regard to the nomenclature of the plants that also occur both in India and in countries beyond the control of the Inspector-General of the Forests in India, chaos and confusion of vast magnitude will be the result. Besides what guarantee can the Inspector give that a conserved misapplication will not be again misapplied, necessitating another committee decision to satisfy the demands of the future users of the second misapplication?

Judging from the way the name *Rhizophora conjugata* L. (Sp. Pl., 1753, p. 443) was being used only a few years ago both in Asia and Europe, it is almost certain that, if votes were taken then, the name would have been conserved for a plant which Linnæus did not intend, and which should actually be called *R. apiculata* Bl. (1827) with *R. candelaria* DC. (1828) as a synonym. Yet Trimen who was well acquainted in Ceylon with Rhizophoraceous plants in the field and had also examined the type drawing in Hermann's herbarium (apparently the sole basis of the Linnean species), showed that *R. conjugata* L. was conspecific with *Bruguiera gymnorrhiza* (L.) Lam. (1797) (Journ. Linn. Sec. Bot. XXIV, 1887, p. 142). *Rhizophora conjugata* L. as until recently understood and as even now used in some recent Asiatic works, is therefore nothing but a misapplication to be rejected under the Rules in order that its correct name *R. apiculata* Bl. might be used, and in order that *R. conjugata* L. might be retained for the plant for which Linnæus had published the name. If now because of some trouble that may be caused to Indian foresters, the Inspector-General's committee retains the Linnean name for *R. apiculata* Bl., then there will be three

names, *R. conjugata* L. *sensu* the Inspector-General's committee, *R. conjugata* L., and *R. apiculata* Bl. current for two plants.

It is almost certain that the nomenclature of the Indian forestry department will not be followed by systematists and other workers not only in Europe and America, but also in Malaya, Indo-china, Netherlands Indies, Philippines, Formosa, China, etc., and perhaps even by systematists in India itself. In the end it might be found that no one, outside the Indian forestry department, would be able to follow the plant nomenclature adopted by the Indian foresters, unless a detailed synonymy were given; and conversely the Indian foresters might not be able to keep in touch with the work that is being done by persons not connected with the Indian forest department but in subjects concerning Indian forest plants. Thus the work of the Inspector-General's committee might hinder rather than aid the progress in the knowledge of the Indian plants themselves.

In my view, therefore, the time is not yet ripe for proposing a list of nomina specifica conservanda. Some time is necessary so that the nomenclature that was in use may be adjusted to the principles of priority and the type-basis concept adopted by the Rules. Detailed investigations are, moreover, necessary in order that misapplications may be detected. Further the methods proposed for interpreting a mixtum compositum or for rejecting nomina ambigua and confusa have also to be worked out. It is only when these methods and investigations have failed to make the nomenclature stable that the nomina specifica conservanda could be undertaken, if actually desired. Otherwise an adoption of a nomina specifica conservanda would mean the perpetuation of errors circulated through careless work and the discouraging of thorough investigations in systematic groups; it would mean that any influential groups of botanists could circulate any amount of misinterpretations and, should anyone less influential but more careful contest the interpretations on the basis of the types, the former could resort to votes in order to perpetuate their misapplications by means of legislation. In the end we may get the Congress degraded into a sort of political parliament where parties would meet, each with the intent of defending, right or wrong, an interpretation proposed by its members.

Instead of trying to influence the botanical nomenclature of Indian plants of forestry importance, it would be better if the Inspector-General of Forests were to use his weight in order to develop the vernacular nomenclature of the plants to be used both by the members of the different forest departments under his charge and by the traders interested in the Indian forest products. Such an attempt might in the long run bring about more clearly certain differences among the species that are now imperfectly known, and thereby might help botanists to clear the status of the species concerned.

21. Effectiveness of Advance Separates

Article 36 of the Rules of Botanical Nomenclature deals with the conditions regulating the effectiveness of a systematic publication, and it reads as follows:

"Publication is effected, under these rules, by sale to the general public or to botanical institutions, of printed matter or indelible autographs, or by distribution of these to specified representative botanical institutions.*

"No other kind of publication is accepted as effective: communication of new names at a public meeting, or the placing of names in a collection or gardens open to the public, does not constitute effective publication."

But at the last Congress (Amsterdam 1935) there was added to the foregoing Art. 36 a further clause, which reads as follows:

"Where separates from periodicals or other works placed on sale are issued in advance, the date on the separate is accepted as the date of effective publication." (Proceedings I, 1936, p. 343).

Now this additional clause is so worded that, I suggest, it makes it possible to secure effectiveness for a publication in a way which the foregoing text of Art. 36 was meant to prevent. It weakens and lessens the effectiveness of the text by not making it obligatory for the authors of separates to distribute these to any specified persons or institutions, a distribution which, in the original text, is the alternative to placing the printed matter or indelible autograph on sale. The effect of the clause is to encourage the printing of works in parts but the distribution only in completed volumes; and yet, because of the separates issued in advance, to legitimize the claim to make the date on the parts or separates (and not the later date on which the volumes were distributed) as the date of their effective publication.

Already the existence of this practice of distributing some institutional publications in volumes, instead of in parts as and when issued, is causing much confusion and inconvenience even to the institutions which maintain an exchange with, or subscribe to, such publications; in as much as the latter institutions are prevented from keeping in touch with the recent advances and progress in systematics of the countries in which they are most interested, being obliged to wait for the information till the completion of the volumes. There is no fixed period within which a volume of such a periodical might be completed and be made available to the public; and it is not uncommon to find botanists accumulating their separates before finally distributing them, simply in order to save themselves the expense of frequent distribution. As a consequence of this lack of immediate distribution of systematic papers several names may be published which later may have to be discarded as superfluous or illegitimate.

* Only a tentative list has been compiled of the representative botanical institutions to be recognized under this Article, but no final agreement has yet been reached as to the names to be included in this list.

If now, encouraged by this new clause, this practice of distributing departmental publications only in completed volumes and not in parts as issued, or of distributing in one year periodicals dated in a previous year, becomes general, one can well imagine the evil effects of the proposed new rule. What amount of unnecessary inconvenience and confusion would have resulted if the sale of the FLORE GENERALE DE L'INDOCHINE was begun only on the completion of each volume, instead of, as hitherto, on the issue of each fascicule, and yet, because of the separates issued in advance as authors' copies, the validity of the publication was to begin on the date on which each fascicule was printed? Some volumes of this flora have actually taken twenty years or more to complete.

Hence if the work is to be effectively published by means of advance separates, these separates should be regarded as works *not offered for sale,* for such they are in fact; and consequently, the clause governing such works should be made to operate. The mere fact that a work is regarded as an advance separate from a regular periodical *to be placed on sale* should not obscure the fact that these separates, at the time of their issue, were *not placed on sale;* and so they should not be exempted from the rule and be allowed to secure effectiveness in publicity without making the work available to the botanical public, principally to those institutions which are most interested in it. Should some accident or economic upheaval destroy the issue of the periodical or cause it to be suspended before the intended completion of the volume, then the papers issued in advance as separates may never become available for purchase. In such an event there might be all the elements to pronounce the work ineffectively published, though the new modification to *Art. 36* would make its publication effective.

Moreover if the principle is admitted of legitimizing a publication at a date when it is issued for private distribution, what is the use of penalizing others who issue independent works and circulate them in a similar manner, simply because no promise has been made to publish them at a later date in a regular periodical? Again, what if the author of such a private work were to announce in it that he would issue at a later day an edition for the public? Which date should systematists then take for the purpose of reckoning the effectiveness of the publication? For, to say that a certain, privately circulated work is an advance separate of a regular periodical is no more than to promise to publish the work later in the periodical which will be released at an indefinite date. Hence the new clause to *Art. 36* would be applicable in this case and would make the first issue of the work effective.

To anticipate the date of the systematic validity of a work on the expectation of certain events to take place at an indefinite future is, I submit, an undesirable procedure. If the date of the

effectiveness of a publication is to be judged, it should be on the action already taken by its author or publisher to make the work available to the systematic public interested in it, and not on the action that the author or the publisher will take, or has promised to take, at some future day.

If an institution finds difficulty in printing and distributing the results of its research work as it progresses, it could publish these results from time to time in those privately owned periodicals which are only too willing to accept them for publication, and the institution could order reprints from the publishers for the purpose of exchange.

From the foregoing it will be seen that the additional clause as it stands introduces a very disquieting element into the Rules and makes Art. 36 practically valueless. The legislators might have been led to adopt the clause owing to its misleading phraseology, for the clause might be easily mistaken for an amendment to Art. 45, which deals with the dates of effective publications. Had the following proposal been made, its undesirability would have been at once apparent; yet it has the same significance as the clause adopted :

"Publication can also be effected, under these Rules, by means of printed matter or indelible autographs not placed on sale, and not distributed to the specified institutions, if they are regarded, at the time of the issue, as advance separates from periodicals or other works placed on sale, it being immaterial whether or not they are actually reprinted in the periodicals or other works".

However the new clause can be made to conform with the text of Art. 36 by the addition of some such words as the following :

"provided that immediately following the issue of separates they be duly distributed to the specified representative botanical institutions."

22. Representative Botanical Institutions under Art. 36

The discussion held at the last botanical Congress in Amsterdam, though short, showed that the tentative list of the representative botanical institutions prepared by Dr. T. A. Sprague and Miss M. L. Green for recognition under Art. 36 was not satisfactory. To be effective the list should conform : firstly, to the needs of the institutions working in the area about which the papers to be validated deal; and, secondly, to the needs of those institutions which, though not situated in the area, are yet directly interested in the studies of the flora. On the other hand, certain institutions neither want, nor have any place to accomodate, systematic papers concerning regions, in the floristic studies of which they are not even remotely interested. Consequently it would be worse than useless to send such papers to them, as these institutions might destroy the papers immediately on their receipt and without keeping any record.

In order to draw up a satisfactory list, it would seem advisable therefore, to divide the entire globe into about a dozen regions,

which need not necessarily be botanical regions, each having the following subdivisions: (*a*) including the important botanical institutions working in the divisions with which the work deals; (*b*) including the important institutions of the neighbouring countries which may be directly or indirectly interested in the flora of the region; and (*c*) including the institutions which, though situated in countries far away from the regions dealt by the work, are interested in the floristic study of the region, as well as the institutions of those countries which have colonial dependencies in the region.

The total number of institutions thus enumerated should not exceed 20–25, and in no country should more than one institution be named, unless the extra institutions in any single country are sufficiently important to be included under (*a*).

With such a list determined upon, it should be made obligatory for an author, desiring to make his work effective for the purpose of systematics, to send copies of his work to the relative institutions under *a*, *b* and *c*.

In the case of an author's work embracing an area falling in more than one regional group, he should send at least to one of the most important institutions in each country named under (*a*) and (*b*) in the groups affected. This latter procedure would meet the case of the author who might be uncertain into which regional group his work should exactly fall; for example a work dealing with the whole of France or with Himalayan regions, or with Tropical America, or Indo-China. This suggested procedure would oblige authors who wish to describe, in one single paper, new species and genera from all parts of the world, to send their papers to an enormous number of institutions. But botanists who would think of preparing such a work for private distribution only should be thus penalized in the interest of science.

It would be further desirable to make this distribution to the specified institutions through a central committee, which should be responsible so to mark every copy thus distributed that botanists consulting any one of the copies will know at once that the work, though not placed on sale, has been effectively published. Such an obligation would render difficult to pass undetected any future offence against Art. 36. Besides without such a committee to keep a check on this distribution, how is one to know, without making a detailed inquiry, that certain privately distributed work sent to one institution is not sent to others specified under the Rules? In view of the difficulties to decide immediately on this matter, a botanist might be induced to accept an ineffective publication as valid and to make accordingly several nomenclature changes, resulting in invalid names passing not only as valid but even as legitimate. If several years elapse before the mistake is discovered, then the

rejection of the invalid names, though circulated erroneously as legitimate, might be resented because of their being long in use. There is also the possibility of some institutions losing the copies sent to them, and, if the institutions are unable to produce records showing whether they had actually received the copies or not, the loss might vitiate any subsequent inquiry into the effectiveness of the work. All such drawbacks would disappear if the distribution of the publications not placed on sale has perforce to be done through a central committee.

A fourth clause (*d*) could be added by way of recommendation including those large institutions or scientific libraries which, though not actively interested in the flora of the region, are willing to accomodate works for the purpose of making them available to research workers, provided these institutions are not already included in *a*, *b* and *c*.

To illustrate all that I have said above, I append the following tentative list (omitting the considerations of palæobotanists who should have their own separate list) which might form a basis for future discussions :—

I. North Europe

(*a*)	1. Austria	2. Belgium	3. Czechoslovakia	4. Denmark
	5. France	6. Germany	7. Great Britain	8. Holland
	9. Latvia	10. Norway	11. Poland	12. Russia
	13. Sweden	14. Switzerland		
(*b*)	1. Bulgaria	2. Hungary	3. Italy	4. Portugal
	5. Spain	6. Roumania		
(*c*)	1. Canada	2. China	3. India	4. Japan
	5. Palestine	6. U.S.A.		
(*d*)	1. Argentine or Brazil	2. Hawaii	3. Netherlands Indies or Philippines	

II. South Europe

(*a*)	1. Bulgaria	2. France	3. Hungary	4. Italy
	5. Portugal	6. Roumania	7. Spain	8. Turkey
(*b*)	1. Algiers	2. Austria	3. Egypt	4. Germany
	5. Palestine	6. Russia	7. Switzerland	
(*c*)	1. Belgium	2. China	3. Great Britain	4. Holland
	5. India	6. Japan	7. Sweden	
(*d*)	1. Brazil	2. Canada	3. S. Africa	4. Netherlands Indies or Philippines
	5. U.S.A.			

III. North Asia

(*a*)	1–3. China (Canton, Nanking & Peiping)	4. India	5. Japan	6. Palestine
	7. Russia			
(*b*)	1. Alaska	2. Canada	3. Formosa	4. Netherlands Indies
	5. Philippines	6. Singapore		
(*c*)	1. Austria	2. France	3. Germany	4. Great Britain
	5. Italy	6. Switzerland	7. U.S.A.	
(*d*)	1. Brazil	2. Sweden		

IV. South Asia

(*a*)	1. Ceylon	2. Formosa	3. India	4. Netherlands Indies
	5. Philippines	6. Singapore		
(*b*)	1. Australia	2. China	3. Japan	4. New Zealand
(*c*)	1. France	2. Germany	3. Great Britain	4. Holland
	5. Italy	6. Portugal	7. Russia	8. Switzerland
	9. U.S.A.			
(*d*)	1. Brazil	2. Canada	3. Sweden	4. Union of S. Africa

V. Africa

(*a*)	1. Algiers	2. Egypt	3. Tanganiyika	4. Union of S. Africa
(*b*) & (*c*)	1. Belgium	2. France	3. India	4. Italy
	5. Germany	6. Great Britain	7. Holland	8. Portugal
	9. Spain	10. Switzerland	11. U.S.A.	
(*d*)	1. Australia	2. Brazil	3. Japan	4. Netherlands Indies or Philippines
	5. Canada			

VI. Polynesia and Pacific Countries

(*a*)	1. Alaska	2. Argentine	3. Fiji	4. Hawaii
	5. Japan	6. Peru	7. U.S.A.	
(*b*) & (*c*)	1. Australia	2. Canada	3. China	4. France
	5. Germany	6. Great Britain	7. Holland	8. Netherlands Indies
	9. New Zealand	10. Philippines	11. Russia	12. Singapore
	13. Sweden	14. Switzerland		
(*d*)	1. Austria	2. Brazil	3. India	4. Spain
	5. Trinidad			

VII. Australia, New Zealand and Melanesia

(*a*)	1–2. Australia (Brisbane & Melbourne)	3. New Zealand		
(*b*)	1. Formosa	2. Hawaii	3. Netherlands Indies	4. Philippines
(*c*)	1. China	2. France	3. India	4. Italy
	5. Japan	6. Germany	7. Great Britain	8. Holland
	9. Singapore	10. Switzerland	11. U.S.A.	
(*d*)	1. Brazil	2. Ceylon	3. Russia	4. S. Africa
	5. Sweden			

VIII. North America and Greenland

(*a*)	1. Alaska	2–3. Canada (Ottawa & Quebec)	4. Mexico	
	5–8. U.S.A. (Berkeley, Chicago, Harvard, New York or Washington)			
(*b*)	1. Argentine	2. Brazil	3. Chile	4. Equador
	5. Japan	6. Paraguay	7. Peru	8. Russia
	9. Trinidad			
(*c*)	1. France	2. Germany	3. Great Britain	4. Denmark
(*d*)	1. Austria	2. China	3. Holland	4. India
	5. Italy	6. S. Africa	7. Sweden	

IX. *South America*

(*a*)	1. Argentine	2. Brazil	3. Chile	4. Equador
	5. Paraguay	6. Peru	7. Trinidad	
(*b*) & (*c*)	1. Canada	2. France	3. Germany	4. Great Britain
	5. Hawaii	6. Holland	7. Mexico	8. Sweden
	9. Switzerland	10. U.S.A.		
(*d*)	1. Australia	2. India	3. Italy	4. Japan
	5. Philippines or Netherlands Indies	6. Russia	7. Spain	

X. *Arctic*

(*a*), (*b*) & (*c*)	1. Alaska	2. Austria	3. Canada	4. China
	5. Denmark	6. France	7. Germany	8. Great Britain
	9. Holland	10. Japan	11. Norway	12. Russia
	13. Sweden	14. Switzerland	15. U.S.A.	
(*d*)	1. Argentine	2. Australia	3. Brazil	4. Hawaii
	5. India	6. Italy	7. New Zealand	8. S. Africa (Union)

XI. *Antarctic*

(*a*), (*b*) & (*c*)	1. Argentine	2. Australia	3. China	4. France
	5. Germany	6. Great Britain	7. Hawaii	8. Japan
	9. Netherlands Indies	10. New Zealand	11. Philippines	12. Russia
	13. S. Africa (Union)	14. Switzerland	15. U.S.A.	
(*d*)	1. Austria	2. Brazil	3. Canada	4. India
	5. Sweden			

23. Summary

In this paper I have attempted to make clear and precise some rules that were obscure, misleading, or defective.

The greatest fault in the Rules is the equivocal use of the words valid and legitimate and their respective derivatives. As defined here, invalid taxonomic names are those that have no status in modern botanical nomenclature, all those that have such a status being defined as valid.

Invalid names and nameless taxonomic groups can be arranged into four main classes:—

(1) those that are ineffectively published;

(2) those that are published in effective but invalid publications;

(3) those that are published in valid publications, but either containing defects in (*a*) the names themselves, and/or (*b*) their descriptions; or (*c*) consisting of only names without any descriptions; and

(4) those that are published in valid publications and with valid descriptions, but without any names whatsoever.

The present usage allows the validation of a taxonomic name by a reference to a valid description of invalid names in Class 3 and of nameless taxonomic groups in Class 4; also permits references also to plates in publications that are rendered invalid under Art. 20; but the wording of Arts. 37, 42 and 44 of the Rules seems to allow references to descriptions and plates published in any books, even popular and non-botanical books and written in any language, provided the conditions for effectiveness as laid down in Art. 36 are complied with. The Rules have, therefore, to be amended so as to exclude references to such non-botanical publications and invalid descriptions. It would indeed be advantageous to admit in future as valid only references to valid descriptions, and plates, in valid publications, defining valid publications to mean such publications as are effectively published and as ordinarily reach systematic botanists.

Provisional names are invalid because of the defects that make their descriptions invalid. Since one may not validate a name of a taxonomic group by referring to an invalid description, it follows that references to provisional names or to their descriptions are not valid.

Valid names may be legitimate or illegitimate. An author, having defined his taxonomic group and assembled together all the rival names of the group, should consult the Rules in finding out the correct name for his group. Under the Rules it should be possible for only one name to be correct for a given taxonomic

group (*i.e.* a group in a given sense, in a given position and in a given rank) : this name is the legitimate name for the group as defined by the author, all others being regarded as illegitimate for it.

Illegitimate names are cited as synonyms, which may be divided into two classes (1) absolute synonyms, consisting of typonyms, isonyms, and/or basinyms, and (2) equivalent synonyms. A third class of synonyms consists of names doubtfully referred to the species or of names based on monstrosities of the species.

As the present wording of the Rules is obscure and equivocal regarding the procedure to be followed in selecting the legitimate name out of the several rivals of unequal ages, three usages are explained, only one of which will have to be adopted in the Rules.

The difference between a new combination and a new name is explained.

Alternative names are simultaneous isonyms; but those simultaneous isonyms that are not new combinations of equal rank should be prohibited.

The Rules oblige one to follow the botanist who first preferred one of the rival names of equal age and equal rank for one species (Art. 56), and one of the homonymous names of equal age (new addition to Art. 61); but it is necessary to add to both these Articles that this preference holds effective so long as the names remain in the same position or genus under which the choice was made. On the transference of any of the names to another position or genus, the author who first made the distinction in the new position should be followed. But in every case the botanist exercising his privilege under Arts. 56 and 61 should see that a new combination gets precedence over a new name, and this over a new species; and also that, among the homonymous names that are isonyms of equal age and equal kind, the one that has the oldest basinym gets the precedence.

Varietal names given to the type form of a species (as in Rec. XVIII) and retained as varieties of it are equivalent to ternary specific names and cannot have a place in modern plant nomenclature. Examples are given to show that such a procedure may also lead to serious confusion.

When a species is to be divided into two or more species and it is not possible to assign the original description definitely to any of its syntypes, then the first author to choose one of them as the lectotype or to transfer the other specimens to different species should be followed. If the syntypes of a species are not extant and the original botanical description combined with

phytogeographical considerations admit more than one interpretation that is not obviously discordant with the original description, then botanists should be obliged to follow the earliest of the interpretations; or if the species has been previously excluded as doubtful, then the name should not be adopted to any taxonomic group, without any adequate botanical reasons or proofs. In my opinion the time is not yet ripe for making a list of nomina ambigua, dubia vel confusa: suggestions for stabilizing names without such lists should first be given an opportunity to do their work in full.

The Rules regarding tautonyms and homonyms appear to be very confusing. It might be better to frame some general rules without attaching any importance to the meaning and origin of the words, provided serious risks of confusing one name with another are avoided. Suggestions are made showing how this rule could be framed.

Since according to Art. 42 generic names in Linnæus's *Species Plantarum*, eds. 1 and 2, are validly published, the purport of the provision under Art. 20 seems to make the generic descriptions in Linnæus's *Genera Plantarum*, eds. 5 and 6, merely supplementary.

It seems logical to write all trivial epithets with a small initial letter, whether or not they are the names of persons or of genera, or their derivatives.

Misapplications cannot be used to validate new species. It is therefore important to adopt a method of citation which will clearly distinguish misapplications from illegitimate homonyms. It is argued that the use of the word *sensu* for this purpose is a rational one.

A brief discussion on the different kinds of nomenclatorial expressions is introduced in order to further clarify the fundamentals underlying them. Though the use of nomenclatorial expressions to indicate errors seems to be an anomaly, yet their conventional use is retained, as they help to refer to errors both concisely and precisely. But they should be used in the way suggested, so that they might not be confused with expressions that do not refer to errors. It is shown again that expressions referring to errors cannot be used as a basinym of a new name. Expressions with *in*, *ex*, and *apud* are also discussed.

The principle of priority and the type-basis concept have been adopted as universal rules only very recently. Time is therefore needed so that plant nomenclature may adjust itself to these principles. It would be detrimental to the interests of systematic botany if *nomina specifica conservanda* were adopted at this stage.

The additional clause voted to Art. 36 by the last Congress is against the spirit of the article itself, as it will legitimize

practices of securing effectiveness in publication which it is the principal object of Art. 36 to prevent.

A principle is here enunciated by which unanimity and satisfaction might be secured in recognizing representative botanical institutions under Art. 36. Reasons have been adduced to show the need of distributing the copies of a publication not placed on sale through a central committee. A tentative list of these institutions is also given.

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THE NOMENCLATURE OF TYPES

By C. X. Furtado, B.Ag.,

Botanic Gardens, Singapore.

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1. Introduction

Not many years ago, when I first became interested in systematic botany, I experienced considerable difficulty in comprehending the full implication of the terms "Type" and "Co-Type". And although systematic botanists have now accepted the principle of the "Type basis Concept", a perusal of recent taxonomical papers combined with a personal inspection of the labelling of specimens in some of the well-known herbaria in Europe leads me to conclude that systematists are not yet agreed on a uniform system of naming both type specimens with their duplicates as well as those specimens that are almost as valuable to taxonomists as the types themselves. This disagreement is all the more surprising when one realises that systematists would be the first to admit the value of uniformity in the naming of type specimens for taxonomic reference. So great, however, is the confusion at present reigning concerning the nomenclature of some kinds of types that it more than bears out the remark made by Dr. Agnes Chase, the well-known agrostologist, with reference to plant nomenclature in general: "Paradoxical as it may sound, it is the effort made during the last twenty years or so to bring about stability and uniformity in the use of names that has caused such a bewildering diversity".

Now in the following summary I have gathered together most of the important terms used to designate type-specimens in the hope that this compilation may provoke the interest of herbarium-keepers in the matter. Obviously, by adopting a

uniform system of naming the type material in their charge, herbarium-keepers would increase considerably the value of the specimens. For the sake of clearness I have had to define again a few old terms and add a few new ones.

One apology I have to make: I cannot now cite authority for every one of the terms adopted in this paper.* This is because the compilation was originally for my own instruction only. However, most of the terms here discussed can be found in Dr. B. D. Jackson's *Glossary of Botanical Terms,* 4th Ed. (1928).

2. Varieties of Types

Nowadays a description of a new species is based on certain specimens, some or all of which are preserved in a herbarium. It is with the uniform naming of these specimens and their duplicates that I am most concerned. But because palæontological botany has its own system of type-classification, palæontological types will not be considered in this paper.

For accuracy in taxonomic work, especially in the revision of species, one must know the status of each specimen: whether, for instance, it was part of the original material on which the species was founded; how it came to be regarded as authentic or by whom it was identified; whether it was selected by the author as typical of his species or if it supplied any particular information. And in the case of duplicates, many other problems arise. For instance, if the original specimens on which an author founded his species are in one herbarium, can one consider the duplicates in another herbarium as equivalent? Did the author examine all the duplicates of each collection of the original material before they were distributed, or had he only one specimen of each at the time he drafted his description.

For taxonomic purposes equivalent duplicates must have been gathered at the same time from the same plant and must have the same collection number (cf. *Isotype* and *Clastotype* below). But it is common for collectors to take their duplicates from several plants of apparently the same species and perhaps at widely different dates, and to give these various specimens an

* After completing my paper I had an opportunity to consult Dr. D. L. Frizzell's compilation entitled TERMINOLOGY OF TYPES, published in *The American Midland Naturalist XIV,* 1933, *pp.* 637–668, and obtainable in a reprint form from the University of Notre Dame, Indiana, U.S.A. Though some terms like Isotype, Isoholotype, Isolectotype, etc. as used in systematic botany have not been recorded, the booklet is of special value as it gives full particulars regarding the authorship of the terms and the place of their publication, as well as references to the subsequent use of the terms in a sense different from the original. There are dealt in it 233 terms or phrases of which the word type, or its variant, forms a part, but only about half of this total number of terms explained pertains to the nomenclatorial types in biology, the others being non-nomenclatorial.

identical field number.* In some cases, as some fungi, herbs and small, little-branched palms, it will be evident from the material whether or not the duplicates are equivalent, but in most other cases it will not be so self-evident; and, should the collection be of some large and difficult genus like *Eugenia, Ficus, Eria, Calamus, Polypodium, Sphagnum* or *Sargassum,* one might doubt the collector's ability to distinguish every species in the field. A collection of such duplicates may be found after a critical study in the herbarium to comprise more than one species so that the duplicates are not equivalent; and if they are distributed before the mistake is realised, much confusion will result.

To avoid such doubts, and for reasons which will be apparent, I propose the following terms for the labelling of type-specimens so that in most cases there can be no doubt of the status of a herbarium specimen and its taxonomic value:

TYPE SPECIMEN: in a strict sense, is a herbarium specimen (*a*) that has been *cited in the original description* as having been seen by the author; or (*b*) if not cited, any original specimen on which the description of the species was based. For convenience all secondary types, which may be either specimens chosen as standards subsequent to the original description of the species or merely specimens matched with the type specimens, and all the duplicates of the type specimens *sensu stricto* and of the secondary types, are called the Type Specimens *sensu lato.* Type specimens *sensu lato* may be divided as follows:

A: Primary Types or **Proterotypes** (*Proteros*=first, former): are the type specimens *sensu stricto.* These are subdivided as follows:—

1. HOLOTYPE (*Holos*=entire): The specimen chosen by the author and cited in his original description as that by which the species must be interpreted.

2. PARATYPE (*Para*=beside): any proterotype other than the holotype.

* One cannot condemn too strongly the practice of lumping together specimens collected from different localities or/and on different dates and then giving the same field or distribution number as if they had been collected on one and the same day and from one and the same field; for under field conditions it could not have been possible for the collectors to compare the specimens, or the plants from which the specimens had been taken, in a living state. Further the specimens so distributed will convey a wrong idea of both the flowering and fruiting seasons of the plants as well as their distribution in the district. This will hold good even when the different localities whence the specimens were obtained lie in the same political or botanical district.

Collectors therefore should make it their rule, as far as possible, to collect from the same bush or plant all the specimens to be included under one field number; or, if this is not possible, to collect simultaneously from different plants growing in the same locality so that they may be compared in the living state in the field by the collector himself.

3. SYNTYPE (*Syn* = with): Any proterotype, if no holotype has been chosen.

B: Secondary Types or **Heterotypes** (*Heteros* = other): These are specimens chosen or studied subsequent to the original description. They may be divided as follows: —

1. LECTOTYPE or LECTOHOLOTYPE (*Lektos* = chosen): A syntype selected as a holotype. If the selection is made by the author of the species himself, then the Lectotype may be termed an IDEOLECTOTYPE. (*Ideos* = peculiar).

2. LECTOPARATYPE: A syntype not chosen for the Lectotype.

3. APOTYPE (*Apo* = from): A specimen on which is based the first correct interpretation of a species of which the description is too inadequate and the proterotypes are too imperfect or abnormal to furnish a clue for its correct identification. If both the types and the specific description cannot be identified except by an historical inquiry into the use of the specific name, then the specimen that supplies the historical clue becomes the *Logo-Apotype* (*Logos* = discourse).

4. TOPOTYPE (*Topos* = place): A specimen from a type locality agreeing with the type.

If it is from the Holotype, Paratype, Lectotype, etc. locality, then the specimen must be called accordingly a Topoholotype, Topoparatype, Topolectotype, etc.

5. ICOTYPE (*Ikos* = what is like): A specimen agreeing with the accepted standard of the species, but not from any Proterotype locality.

6. NEOTYPE (*Neos* = new): A specimen agreeing with the original description of a species, and selected as the type when no material from the proterotype collection exists.

According to the locality from which the Neotype is obtained, the specimen would be called Neotopotype (from the Holotype or Lectotype locality), Neoparatype, (from the Paratype locality), or Neoicotype (not from any Proterotype locality). (*See* also under *Proteromerotype* below).

7. IDEOTYPE or IDIOTYPE (*Idios* = peculiar or own): A specimen identified by the author as typical of his species.

According to the place whence the specimen was collected, it could be Ideotopotype, Ideoparatype, etc. (*see* also under Lectotype and Proteromerotype).

8. PROTEROMEROTYPE (*Meros* = a part): A specimen taken from the holotype plant because no herbarium material was preserved at the time of description.

If the specimen was taken by the author of the species, then the specimen may be called *Ideoproteromerotype* or simply *Ideomerotype* (cf. also *Merotype* below).

C. Duplicate Types or **Antitypes** (*Anti*=against; instead of): These are specimens purported to have been collected by the same collector at the same time and in the same place, and bearing the same number (if any) as the primary or the secondary types; or else fragments taken from types; or specimens derived from plants raised vegetatively or by seed from the type plants. They may be classified as follows:—

1. ISOTYPE (*Isos*=equal to): A specimen collected from the same plant as the type, at the same time, and bearing the same collection number.

2. HAPTOTYPE (*Hapto*=I fasten upon): A specimen purported to have been collected simultaneously with the type and bearing the same collection number, but not certainly from the type plant.

3. MEROTYPE (*Meros*=part): A specimen taken from a type plant but not simultaneously with the type, and consequently with a different number (cf. Proteromerotype).

4. CLONOTYPE (*Klon*=a young shoot): A specimen from an asexual offspring of a type-plant.

5. SPERMOTYPE (*Sperma*=seed): A specimen from the seed or spore offspring of a type plant.

6. CLASTOTYPE (*Klastos*=broken): A fragment of a type specimen.

Note.—According to the status of the type-plant (*vide infra*), or type-specimen, from which these duplicates were obtained, so these prefixes can be added to define the duplicates more precisely *e.g.*: Isoholotype, Iso-paratype, Iso-apotype, Iso-neotype, Haptoneotype, Mero-holotype, Clonoparatype, Spermolectotype, Clastoproteromerotype.

3. Explanations of these Terms and Examples

1. PRIMARY TYPES:—In many older and also in some modern works on botany the specimens actually studied and on which the authors based their species are not cited. But from the range of distribution given for the species and from the history of the specimens together with any notes by the persons who studied the specimens, it is often possible to find out the specimen or specimens on which the species was based. Such specimens, therefore, though not cited in the original description, are also to be included in the *Primary Types* as defined herein.

Example 1:—*Dæmonorops pseudomirabilis* was described by Beccari as a new species but with the following particulars under its habitat or range of its distribution: "Cultivated at Buitenzorg,

from Palembang in Sumatra" (Rec. Bot. Surv. Ind. II, 1902 p. 226). Here no definite specimen is cited, though the holotype is in Beccari's herbarium, now forming the part of Webb's Herbarium in Florence.

Example 2:—In the *Catalogus Plantarum in Horto Botanico Bogoriensi Cultarum,* II, 1844, p. 58, Hasskarl published a new aroid, *Scindapsus pictus,* with a brief specific description only, without citing any specimens whatsoever or giving the range of the distribution of the species. Should there exist any specimens on which Hasskarl based the specific description of his species, those specimens will have to be included under the Primary types. If only one, it will be the Holotype of the species.

2. HOLOTYPE and PARATYPE:—Botanists frequently call the Holotype the "Type", but it is convenient to have the term Type (*i.e.* Type-specimen) with a more general meaning to indicate any specimen which is recognised as typical of the species. It is not essential to indicate directly the Holotype, indirect indication being quite sufficient. But, in order to be valid, indications of the Holotype, whether direct or indirect, must be made in print and simultaneously with the publication of the species itself. As for *Chirotypes* (types indicated in herbarium only and not in literature or types of manuscript species), these cannot be taken into account to the prejudice of published types. If only one specimen was cited by the author of the species, or if there was only one specimen for study and that was not cited, then that specimen becomes the holotype.

Example 1:—In the case of *Dæmonorops pseudomirabilis* (see the *Example 1* under the Primary Types) only one specimen derived from the plant cultivated in the Buitenzorg Botanic Gardens, was studied by Beccari. That specimen therefore is the holotype of the species.

Example 2:—F. von. Mueller, in erecting a new species, *Livistona Mariæ,* made the following observations: "Descriptio fructus, *quæ species præcipue limitat* solummodo e speciminibus occidentalibus pendet quum tantummodo foila hujus palmæ superbæ ex Australia centrali possideo, sed plantam ex utraque regione conspecificam arbitror" (Fragm. Phyto. XI, 1878, p. 54). Since the delimitation of the species was said to have been based chiefly on the fruits, it means that the West Australian specimen which bore fruits, and not the Central Australian one which was sterile, is the Holotype of Mueller's species. (The Central Australian is a paratype). When, therefore, Mueller recognised that the Central Australian plant was specifically distinct from the West Australian, he could not reserve the name, *L. Mariæ,* for the former and give the latter (the Holotype of *L. Mariæ*) the new name, *L. Alfredii,* (Vict. Nat. XI, 1892 p. 112). If a new species had to be erected to distinguish between two kinds of palms, then the paratype of *L. Mariæ* (but never the holotype) could have been made the Holotype of the new species (cf. also Art. 52 of the Internat. Rules Bot. Nomencl., 1935).

Example 3:—Under the habitat of *Amomum terminale,* Ridley (in Journ. Roy. Asiat. Soc. Straits Br. XXXIV, 1900, p. 98,) the author of the species gave the following particulars: "Bismarck Archipelago (Micholitz). Flowered in the Botanic Gardens, Singapore, Feb. 1900". The description itself was obviously derived chiefly from a living plant. Hence only the specimen taken from the plant cultivated in the Singapore Gardens and studied in detail by Ridley must be regarded as the Holotype. Should it be necessary, at any

future date, to regard Micholitz's own specimen from the Bismarck Archipelago as distinct from the one that was derived from the plant cultivated in the Singapore Botanic Gardens, then the name *A. terminale* Ridl. should be retained for the specimen derived from the cultivated plant.

Example 4:—In REINECKE, Fl. Samoa-Ins. in Engl., Bot. Jahrb. XXV (1898) 588, Warburg published a new binomial under *Cyphokentia* thus :

> "C samœnsis Warb. (prob. = *Clinostigma samœnse* Wendl.) Bonplandia X (1862) 196)
> "Upolu : Mai 1894 (n. 322)".

Now this binomial of Warburg is being taken not as a new combination based on Wendland's species cited above in the synonymy, but as a new species with Reinecke's specimen from Upolu in Samoa as the holotype. But from Warburg's remarks on the species it is evident that the binomial is an isonym of Wendland's species (*i.e.* Wendland's species is the holotype of Warburg's binomial) and that the word "prob." following the binomial was added to indicate that Reinecke's specimen was referred to the species with some doubt. I transcribe here the portion of Warburg's remarks that is most pertinent to the point in question :

"Dass diese Art mit *Clinostigma samœnse* identisch ist, erscheint mir nach WENDLAND'S Beschreibung (Bonplandia 1862, p. 196) zwar sehr wahrscheinlich aber nicht ganz zweifellos ; nach derselben ist z. B. die Rachis der Hauptverzweigungen des Blütenstandes viel dicker (15–20 mm, bei unserem Exemplar nur 3–8) ; .... Er betont mit Recht, die Verwandtschaft der samoanischen typischen Art mit *Cyphokentia,* und ich sehe in der That nicht den mindesten Grund, warum unsere samoanische Art, sowie auch der WENDLAND' sche Typus der Gattung *Clinostigma* nicht zu *Cyphokentia* gehören soll, namentlich nicht in der weiteren Fassung Drude's in ENGLER-PRANTL.

"Ausser dieser Art werden noch 2 Arten zur Gattung *Clinostigma* gebracht————[Warburg then refers to an undescribed species and *Cl. Mooreanum,* but not to *Cl. samœnse* Wendl.].

Further, whereas in Reinecke's paper above quoted (cf. *op. cit.* Pandanaceæ pp. 578–581 ; Palmæ pp. 588–592 ; Ficus pp. 613–617) Warburg published a new species invariably with a diagnosis in Latin and with an "n. sp." at the end of the binomial, he did neither of these things in the case of *Cyphokentia samœnsis,* being content to quote Wendland's species as a synonym and to show how Reinecke's specimen differed from Wendland's description of *Cl. samœnse* Wendl.

This procedure of interpreting a new isonym (=new combination or new name) is also in accord with the new International Rules of Botanical Nomenclature, ed. 1935 (cf. Art. 54), which prohibit the adoption of a new holotype for the species which has been transferred from one genus to another, the prohibition being valid whether or not this transference is accompanied with a new description drawn from a different plant or species (The case discussed in *Example 2* under SYNTYPES stands on a different footing).

In view of the above, one has to treat *Cyphokentia samœnsis* Warb. not as a new species, but as an isonym of *Clinostigma samœnse* Wendl.

Hence to avoid future complications and misinterpretations of the binomial *Clinostigma Warburgii* Becc. in Atti Soc. Tosc. Sci. Nat.

XLIV, 1934, p. 44,* I asked the late Count Professor Martelli to insert the words "quoad icon. et specimen a Reinecke lectum" immediately after its synonym, *Cyphokentia samœnsis* Warb., and to add the diagnosis in Latin, though in his manuscript Beccari had considered *C. samœnsis* Warb. as a new species independent of Wendland's, and treated *Cl. Warburgii* Becc. only as a new name for the former.

Example 5:—*Ixora nigricans* R. Br. made its appearance as a *nomen nudum* in Wallich's *Catalogue* (1828) n. 6154 and in Wight's *Catalogue* (1833) n. 1335. In 1834, however, it was published with a description in *Prodromus Floræ Peninsula Indiæ Orientalis* Vol. I, p. 428 by Wight and Arnott, who after quoting the references to the two catalogues, make the following remarks:

"This was sent to Dr. Wallich by Dr. Wight, but is not noticed under any of the letters of n. 6154; it perhaps, therefore, forms another species in the List, although we cannot see any difference between it and *I. nigricans*".

It is evident from this quotation that, though Wight and Arnott seem to take *I. nigricans* R. Br. in *Wall. Cat.* as a validly published species, yet the description they have given in the *Prodromus* is entirely of Wight's specimen. That this conclusion is correct is further confirmed by the observations Robert Wight has made in his *Icones,* which consist of figures of the Indian plants described in the *Prodromus* and in Wight's *Illustrations of Indian Botany.* After quoting bodily the description (with one or two verbal additions) Wight writes as follows:

"Some points of the character do not accurately correspond with the figure, which may be accounted for by the former being taken from dried specimens, the latter from the fresh plant; the divisions of the stigma do not separate at first and the mature berry is globose and purple, not unlike a small black cherry, but changes in drying." (Icones I, 1840, t. 318).

Now since *Arts. 36 and 37* of the botanical *Rules* ed. 1935, do not recognize any of the names in the two above quoted *Catalogues,* even though these names had been placed on herbarium duplicates and thus made available to several botanical institutions, it follows that the binomial *I. nigricans* became systematically valid only with the botanical description published by Wight and Arnott; and as this description was based entirely on Wight's specimen n. 1335, this specimen is therefore the holotype of the species, which ought to be quoted as *I. nigricans* Wight and Arnott, *Prodr. Ind. I.* (1834) 428, though the *Rules* also permit one to quote it as *I. nigricans* R. Br. *ex* Wight and Arnott, despite the fact that the type of the species is not any of the specimens that R. Brown had seen.

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* It may be noted here that, owing to ill-health of the late Count Professor Martelli, I was entrusted to frame all the diagnoses in Latin for Beccari's new genera and species published in the *Atti* so that the genera and species may be validated according to the resolutions passed by the International Botanical Congress, Cambridge, 1930. But before the paper was out and when it was too late to make any changes in it, a modification to this resolution was announced (*Journ. Bot. LXXII,* 1934 Suppl.) whereby the diagnoses in Latin were rendered unnecessary since Beccari's diagnoses were all in a modern language (Italian) and published before the end of the year 1934—two conditions that required to be satisfied in order to legitimize any new taxonomical unit published in any language other than Latin.

I mention these facts so that systematists may know which views to follow should they notice any discrepancies between the Latin and the Italian descriptions.

From this it is obvious that any interpretation of the species by a reference to any of the specimens distributed by Wallich under 6154 A-D is not permissible, though these specimens may be included as the paratypes of the species.

According to King the specimens distributed under Wallich's Cat. n. 6154 are of more than one species. (*Materials Fl. Malay. Pen. IV,* 1904 p. 149). Probably the failure to recognize this, and also to accept Wight's specimen as the holotype of *I. nigricans* has contributed to a great deal of confusion over the species.

3. SYNTYPE:—If the author has not indicated either directly or indirectly the Holotype specimen and if there are more than one Proterotype, then all the Proterotypes are called Syntypes of the species. No species, therefore, can have both the Holotype and Syntypes, or Paratypes and Syntypes. In its original sense the term *Co-type** (*Co* = *Cum* = with, together) is also synonymous, but because Cotype has been used loosely for Paratype, Isotype, Haptotype or Merotype as well, I propose to drop the term in favour of Syntype, which is now becoming popular (*See* also Lectotype).

Example 1:—In Philipp. Journ. Sci. 58 (1935) 14, Danser quoted the specimen *leg.* Ramos and Endano n. 38740 in the Manila herbarium as the type (=holotype), and its duplicates in the herbaria of Berlin, Leiden and Buitenzorg as the cotypes, of his species, *Amylotheca amplexicaulis.* As all the three latter specimens were definitely cited by Danser as examples of his species, the term "cotypes" was used here to indicate the specimens that are both paratypes as well as haptoholotypes (=duplicates of holotypes) of the species.

In another case (op. cit. Vol. 58, p. 23) Danser indicated the specimen *leg.* McGregor n. 43873 from the Manila herbarium as the type (=holotype), and its duplicates in the herbaria of the New York Botanic Gardens and of the University of California, Berkeley, as the cotypes, of *Loranthus cordilimbus* Merr. (synonym of *Amylotheca saccata* Dans.). But as Merrill has not referred in his description to the duplicates of the holotype as examples of his species (op. cit. 30, 1926 pp. 389 and 391), it follows that by the term "cotypes" Danser merely means haptoholotypes.

Example 2:—In *Prodr. Flor. Nov. Holl. I* (1810) 225, Robert Brown published the new binomial, *Heleocharis capitata,* to include a species which he had collected in Australia, with the following remarks:

> "Scirpus capitatus Linn. sp. pl. ed. Willd. I p. 294 (secundum synonyma Brownei et Sloanii, sed a planta virginiana Herb. Gron. diversus; hæc autem, quoniam Linnæus, cum primum Sp. pl. edebat, nullum hujus exemplum in herbario suo habebat, istius speciei unica auctoritas est.).
>
> Scirpus culmo nudo, spica terminatrice subrotunda. Hort. Cliff. 21 (fide speciminis Herb. Cliff)".

Here Brown does not state that his species is either *S. capitatus* L. *sensu* Willd. or *S. capitatus* Willd. *excl. syn Linn. et. Gronov.,* but that the Linnean species with its type specimen from Virginia in the Gronovian herbarium [*i.e.* Clayton's plant] is not his *Heleocharis capitata,* that *S. capitatus* L. *sensu* Willd. is a mixed species, and that, as far as is known to him, only Willdenow's synonyms referring to Patrick Browne and Sloane are to be included in his species.

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* As a rule Zoologists use this term correctly to mean syntypes.

Consequently it is illegitimate to treat *Heleocharis capitata* R. Br. as a new combination based on *Scirpus capitatus* Linn., *Sp. Pl.* I (1753) p. 48, and thus make precisely the plant that R. Brown excluded from his binomial the holotype of Brown's species. Despite the current practice, therefore, it is right to look upon *H. capitata* R. Br., not as new combination, but as an entirely new species, having for its syntypes the following specimens: R. Brown's specimen from Australia [Gulf of Carpentaria]; Clifford's specimens; and the Jamaican specimens from Sloane's and Browne's herbaria: all of which were referred by R. Brown in his description or remarks. The Caribæan (West Indian) specimens that Willdenow referred to *S. capitatus* are not to be included among the syntypes of Brown's species, nor should Willdenow's name be added in brackets after Brown's binomial and before Brown's initials (as it has been done by Dr. O. A. Farwell in Rhodora XXXII, 1930, p. 181) (cf. *Example* 4 under Lectotype).

Note:—Several botanists including C. B. Clarke (Journ. Linn. Soc. Lond. XXX, 1894, p. 310), Dr. S. F. Blake (Rhodora XX, 1918, p. 24) and Dr. O. A. Farwell (Rhodora, XXXII, 1930, p. 181) have ignored altogether the remarks made by R. Brown to the effect that at the time of the first edition of the *Species Plantarum* (1753) no specimens of *Scirpus capitatus* existed in Linnæus's herbarium, and have accordingly caused a good deal of confusion over the interpretation of *S. capitatus* and *Heleocharis capitata,* Clarke and Blake going to the length of treating the former binomial as the "basinym" of the latter. It is true that there are now in the Linnean herbarium two specimens both named as *S. capitatus* by Linnæus himself; but at the same time there is no valid reason to disregard R. Brown's note about their non-existence there in 1753. On the contrary the fact that neither of the specimens was listed by Linnæus in the three enumerations of his herbarium supports R. Brown's contention. Mr. J. E. Dandy of the British Museum, London, who has looked up the matter, at my request, informs me that one of the specimens identified by Clarke (l. c.) as *H. ovata* was received from Kalm, and that the other representing *H. caribæa* was from P. Browne.* Mr. Dandy has also verified that *H. capitata* R. Br. is identical with *H. geniculata* (L) Rœm. and Schult. quoad var *B,* the diagnosis from *Hort. Cliff.* quoted by R. Brown being according to the original. This means, therefore, that *H. caribæa* (Rottb.) Blake and *H. capitatus* R. Br. are synonyms of *H. geniculata* (L) R. and S. as here interpreted (vide *Example 4* under Lectotype) and also that the species that pass as *H. geniculata* and *S. capitatus* should be known respectively as *H. elegans* Rœm. Schult., and *H. filiformis* (Lam.) Kunth=*H. tenuis* (Willd.) Schult.

Example 3:—In Floræ Siamensis Enumeratio II, pt. 2 (1934) 147, the late Prof. W. G. Craib published a new variety, *Ixora affinis* Wall. *ex* G. Don var. *arguta* Craib *comb. nov.,* by the following citations:

> *I. arguta* R. Br. *ex* King in Journ. As. Soc. Beng. LXXII, 2 (1904) p. 74. *I. nigricans* R. Br. *ex* Wight et Arn. var. *arguta* Hook. f., Flor. Brit. Ind. III (1880) 149 *pro parte.*

After enumerating several specimens from the Peninsula Siam, Prof. Craib indicates that, outside that region, this variety occurs only in the Malay Peninsula and that its type (=holotype) is from Penang; but as no specimen from Penang was quoted by Hooker, who was the first to make the valid use of the term *arguta* in the synonyms quoted above, it seems worth while to investigate the exact status of the types of all the three names.

* Linnæus acquired Browne's herbarium in 1758. Browne published his Natural History of Jamaica in 1756.

Under *I. nigricans* var. *arguta,* Hooker cited only two specimens, both of which are from India, one from Heyne (the only one cited in Wallich's Catalogue n. 6157) and the other from Ritchie; and, though the species proper is said to occur in Burma and the Malay Peninsula, Hooker has not made any definite statement as to the occurrence of the variety outside India.

Now King, *l.c.* discovered that Wallich's n. 6154 A-D, to which the manuscript name *I. nigricans* R. Br. was first attached though not validly published, represented more than one species and concluded that Hooker had made a muddle of *I. nigricans* in having quoted for it Wallich's n. 6154 without any distinction of letters, King having overlooked the fact that *I. nigricans* was validated much earlier than Hooker by Wight and Arnott in their *Prodromus I* (1834) 428, a reference also given by Hooker, and that, therefore, the species had to be interpreted by a reference to Wight's n. 1335 (*vide Example 5* above under Holotype). In the hope of getting over this confusion erroneously attributed to Hooker, King restored *I. ?arguta* R. Br. in Wall. Cat. n. 6157 for the Malayan plant referred by Hooker to *L. nigricans,* but quoted at the same time *I. nigricans* var. *arguta* Hook. fil. as a synonym and made the following observations on the types:

"The type specimens of this [species] in the Wallichian Catalogue [n. 6157] consist of two sheets distinguished by the letters A. and B. The former was received from Herb. Heyne, and is therefore supposed to have come from Southern India. Sheet B is attributed to Penang."

Now according to Art. 58 of the botanical Rules, King was not obliged to adopt the trivial name *arguta* for his species, even though the species was to be validated by citing *I. nigricans* var. *arguta* Hook. f.. But having adopted the name, cited the variety in the synonymy, and quoted at least one of the two syntypes of the variety as a type of the species, King's species cannot be regarded except as a new combination based on Hooker's variety. One is not at liberty to assume that King had drawn his specific description entirely from the new set of specimens and that he had not personally seen any of the syntypes of Hooker's variety, regarding Heyne's specimen seen by King as the duplicate of Hooker's syntype (cf. Arts. 18, 49, 50–52). In Wallich's Catalogue only one specimen is listed under n. 6157 without any distinctive letter, and that one is from Heyne, which is also quoted as the syntype of Hooker's variety. As Hooker did not cite any specimen from Penang, Wallich Cat. n. 6157–B from Penang cannot be included among the syntypes of King's *I. arguta,* unless it can be satisfactorily shown that the omission was clearly a printer's error or a lapsus calami. If it is proved that Ritchie's specimen cited by Hooker is distinct and cannot be included under the variety, then Heyne's specimen will become the Lectoholotype of *I. arguta* King as well as of *I. nigricans* var. *arguta* Hook. f.

Now if Prof. Craib was of the opinion that neither of the syntypes of Hooker's variety corresponded to the Malayan specimens referred by King to *I. arguta* and still considered that his own variety *I. affinis* var. *arguta* should refer only to the Malayan specimens cited by King, and not to any of the two Indian specimens referred by Hooker, then he could not validate the variety by citations. He could have however quoted the synonyms and shown how the syntypes of Hooker's variety were to be excluded. But since he has not followed this procedure, it means that, despite the use of *pro parte* after Hooker's trinomial quoted in the synonymy of *I. affinis* var. *arguta* Craib, the latter variety has to be considered as a new combination entirely based on Hooker's variety, and that the syntypes of the former are precisely those of the latter and not any more or less. In new combinations the Rules do not allow a person to choose a new

set of syntypes from specimens that are not the primary types of the original species or variety on which the combination is based (Arts. 18, 49, 50–52 and 55).

4. LECTOTYPE:—Where there is reason to doubt whether the syntypes are specifically identical it is useful to distinguish one specimen as the Lectotype. And it is advisable that a competent systematist should make this selection. It is futile merely to choose the specimen first cited in a description where the order of citation has no such preferential significance. Besides no specimen is likely to be uniformly accepted as the standard (Lectotype) of a species unless cogent reasons are brought in favour of the selected specimen. Where there are equally good botanical reasons in favour of more than one specimen being chosen as the Lectotype, systematists must, in the interest of stability of the nomenclature, accept as the standard of the (original) species the first published choice of a Lectotype.

Note:—I wish to protest against unnecessary alterations being made in the status of the syntypes even when the changes made are by the author of the species himself. If an author desires to bind the interpretation of his species to any one particular syntype, then to make the binding valid he must indicate, at the time of publication of the species, that specimen as the holotype (unless of course the omission from the original description is a *lapsus calami* or the fault of copyists or printers, in which case correction should follow as early as possible). Later when the specific binomial has become, by publication, an entity in the dominion of taxonomical science, the author has as much or as little right as anybody else to make valid alterations in any part of the species. If, subsequent to the publication of the species, an author who has omitted to name the holotype in the original description, doubts the specific identity of the syntypes or fears a misinterpretation of his species, he should investigate the entire species again and choose a lectotype; or, if that is not possible, he should indicate both the specimens on which he had based the most important portion of the specific diagnosis, as well as those which appear to him to be not typical of the species, though not cited in the original description. But a lectotype should not be chosen unless it is really necessary; in other words, if a botanist examining the syntypes of a species cannot find any specific or varietal difference among them, he should not distinguish one as a lectotype. This procedure will not only prevent a systematist from making an unnecessary or haphazard distinction among the several syntypes and avoid thereby a misdirection of future studies regarding the species and the types, but also oblige him, before selecting the Lectotype, to show the need for distinguishing one syntype from another.

Example 1:—In 1931 Dr. E. Hultén and Dr. H. St. John jointly published a new aroid, *Lysichitum americanum*, without indicating the Holotype (*Svensk Bot. Tidskr.* XXV, 1931 pp. 153–464). Though

the paper was published jointly, they elaborated their work in two different places, the senior author in Europe and Asia, the junior author in America; and they admitted that even at the time of publication they had not had an opportunity to complete the revision side by side. Later, apparently they met in America and jointly selected a specimen which, for several reasons, seemed to them best "fitted to stand as the type of the new species". (*Op. cit.* XXVIII, pt. 2, 1934). Though this selected specimen is proposed as the Holotype, it is evident from the definitions proposed above that it may not be accepted except as a Lectotype, and, being chosen by the authors of the species themselves, it can be labelled as an *Ideolectotype*. Should, in future, the species prove to be composite, it is questionable whether one should abide by this Ideolectotype. An objection that becomes at once apparent is that, up to the time of the publication of the species, the senior author had not seen the specimen later chosen as Ideolectotype, while it is not sure whether the junior had based on the specimen any portion of his conclusions regarding the new species. But, if no serious objection is found against this Ideolectotype, preference should certainly be given to it in any future investigation concerning the status of the species.

Example 2:—Having shown that the syntypes of *Dæmonorops propinquus* Becc. belong to more than one species, I retained this specific name for Griffith's fruit-bearing specimen (a syntype of *D. propinquus*) and transferred Forbes's specimen (another syntype) to another species (*D. confusus*) then described in *Gard. Bull. S.S. VIII*, 1935 p. 347 and 348. Griffith's specimen becomes accordingly the Lectotype of *D. propinquus* Becc. It should not be permissible to disregard this first selection of the Lectotype on such trivial grounds that the specimen was not the one cited first in the original description or on the ground that it was Forbes's specimen which had suggested to Beccari the specific epithet "propinquus". Or else the nomenclature of both the species (*D. propinquus* and *D. confusus*) will become unstable.

Example 3:—Retzius pointed out in his Observations Botanicæ IV (1786) 20 that the Linnean species, *Poa amboinica,* agreed in its description with a specimen from India, distributed under that name by Kœnig, while the Rumphian species, *Phœnix amboinica montana,* cited in the synonymy by Linnæus was totally a different species both as regards its description and as regards its illustrations. Retzius therefore excluded the Rumphian species from the synonymy of *P. amboinica* L., giving, at the same time, a fuller description of the species represented by Kœnig's plant, to which Retzius exclusively reserved the Linnean binomial. It is not known whether Retzius had with him Linnæus's type; but from historical ground it appears certain that Linnæus had based his specific description of *P. amboinica* on a specimen collected by Kœnig in S. India. Kœnig's specimen in Retzius's herbarium (in Lund) becomes either the Lectotype of the species if the specimen was the same as the one studied by Linnæus; or, if not, the specimen is a Neotype or, to be more precise, a Neotopotype, and it will remain so unless the specimen actually studied by Linnæus is discovered, when the specimen in Retzius's herbarium would become merely a Topotype.

Note:—Though the fact that Retzius had excluded the Rumphian species from the synonymy of *P. amboinica* L. was at times overlooked, Retzius's interpretation of the species was almost universally accepted until Dr. E. D. Merrill (Interpr. Rumph. Herb. Amb., 1917, p. 88) made a new combination *Andropogon amboinicus* (L) Merr., on the supposed grounds that *P. amboinica* L. was entirely based on *Phœnix amboinica montana* Rumph.. After an extensive inquiry into this subject, Mr. C. E. Fischer (Kew Bull., 1934, pp. 398–400) came to the conclusion that Linnæus had based his description of *P.*

amboinica on a specimen from S. India sent to him by Kœnig and that the Rumphian species quoted in its synonymy is altogether a different species, belonging neither to the genus *Poa* in the Linnean sense, nor to *Eragrostis* to which Kœnig's specimen and the Linnean description of *P. amboinica* are now referred. In other words, Mr. Fischer admits that the specimen on which Linnæus based the chief part of his specific description was not the Rumphian species, but a specimen from Kœnig. But because the Rumphian species had suggested to Linnæus the trivial name for Kœnig's plant, Mr. Fischer concludes that the specific epithet in *P. amboinica* L. should be reserved for the Rumphian species referred to the genus *Andropogon* by Merrill. Thus Mr. Fischer maintains that the Rumphian species must be accepted as the Lectotype of *P. amboinica* L., so that *Andropogon amboinicus* (L.) Merr. (1917) is a legitimate combination, and that *P. amboinica* L. *emendavit* Retzius (1786)=*Eragrostis amboinica* [*amboinensis*] (L. *emend.* Retz) Trinius (1840) is illegitimate as a name for *Poa riparia* Willd. (1803)=*Eragrostis riparia* (Willd.) Nees (1829). The reasons given by Mr. Fischer for discarding Retzius's legitimate interpretation of *P. amboinica* L. are botanically of minor importance (cf. *Example 2* above); and so in the interest of stability in the nomenclature of the species included in the original *Poa amboinica* L. the newer interpretation by Dr. Merrill and Mr. Fischer should not be possible.

Though *Art 52* of the International Rules of Botanical Nomenclature, 3rd Ed. (1935) is incomplete, as the Appendix *I* which promises to regulate the choice of Lectotypes is not yet published, one can successfully maintain that Linnæus had not fully studied the figures and description of *Phœnix amboinica montana* Rumph., (pre-Linnæan), and that the only plant he had studied in detail and on which, moreover, he had based his diagnosis was a specimen either sent to him by Kœnig, or raised by Linnæus from the seeds sent by Kœnig. Therefore the type of *Poa amboinica* L. must be Kœnig's plant and not the Rumphian species which Linnæus had cited presumably as an approximate synonym of *P. amboinica;* if the type has been lost, Retzius has provided a Neotopotype. But even granting that both Kœnig's plant and the Rumphian species have each an equal claim to be chosen as the Lectotype, it seems but right to allow the author who first recognised the mixed composition of a species to select the Lectotype. A parallel may be found in *Art. 56* of the Rules which confers full rights on the author to choose, when uniting two or more species of the same date, any one of the specific epithets as legitimate for the group resulting from the union of the species, unless of course the resulting binomial becomes a tautonym or a later homonym. Such reasons as the unsuitability of the trivial name cannot be successfully adduced against an already published choice.

Example 4:—SCIRPUS GENICULATUS L., Spec. Pl. I (1753) 48, with description, *Scirpus culmo tereti nudo, subglobosa terminali,* was based on at least three syntypes: **(a)** *Scirpus culmo nudo, spica terminali* [*terminatrice*] *subrotunda* L., Hort Cliffort. (1737) 21; **(b)** *Juncus aquaticus geniculatus, capitulis equiseti, major* Sloane, Cat. Pl. Ins. Jam. (1696) 37; Voy. Jam. Nat. Hist. I (1707) 121 t. 81 fig. 3; and **(c)** *Juncus aquaticus geniculatus, capitulis equiseti, minor* Sloane, *id.* Cat. (1696) 37; *id.* Voy. (1707) 122 t. 75 fig. 2. [There is also a specimen in Linnæus's herbarium named by Linnæus himself as "Scirpus geniculatus 3", which, according to Mr. Dandy, was not in the Linnean herbarium in 1753 and so it has not status as regards the typification of *S. geniculatus*: its spike is long and cylindric and not subglobose as described by Linnæus. It has long been referred to *Heleocharis interstincta* (Vahl) R. Br. (cf. C. B. Clarke, in Journ. Linn. Soc., Lond. XXX, 1894, p. 309)].

The types of the Sloane references are still extant, and Mr. E. J. Dandy, of the British Museum, London, informs me that the type of *Juncus————major* pertains to the long-spiked species commonly known as *H. geniculata,* and that of *Juncus————minor,* like that of *Scirpus————subrotunda* Hort. Cliff. 21, represents a small round-headed species, identical with *H. capitata* R. Br. (=*H. caribæa* Blake) and agreeing with the Linnean description of *S. geniculatus.* Since the type of *Juncus————major,* Sloane, does not accord with the Linnean description, it also cannot be chosen for the Lectotype of the species. This means that the current interpretation of the species *Heleocharis geniculata* (L.) Rœm. and Schult. is erroneous, being applicable to the species that should be known as *H. elegans* (Humb. and Kunth) Rœm. and Sch.

These two exclusions leave still two more syntypes, out of which the Lectotype of *H. geniculata* must be chosen. In this connection, it must be noted that, though Sloane's references seem to have suggested to Linnæus the specific epithet "geniculatus", the Hortus Cliffortianus supplied the bulk of the specific description that accompanied the publication of *S. geniculatus* in Linn., Spec., Pl. I (1753) 48, and since this Hortus Cliffortianus reference also alludes to the syntype with which Linnæus was best acquainted (Linnæus having examined and described it in the Hortus), the specimen in Clifford's herbarium should, therefore, be considered as the Lectotype of *H. geniculata* (L.) Rœm. and Schult. as *emended* here. Sloane's type of *Juncus————minor,* with which Linnæus was less acquainted, and on which the specific description was not based, becomes, thereby, its Lecto-paratype. cf. Note on the syntype: *Example 2.*

5. APOTYPE:—From the definition given above it will be seen that an Apotype is not merely a specimen that helped to complete the description of a species; rather it is one that helped to supply the chief diagnostic or identification clue lacking both in the original description and the proterotypes of the species. This definition slightly alters the meaning given in Jackson's *Glossary* where the term Apotype is defined as a "supplementary type aiding the completion of descriptions"—a definition that would include also the Topotypes and Icotypes as defined here (*vide infra*).

Example 1:—In this category will come any specimen that helped first to identify definitely the species, which, like *Scindapsus pictus* Hassk., *Scindapsus argyræus* Engl. or *Pothos pinnatus* Wall., were based on juvenile forms or sterile specimens.

Example 2:—*Pinanga maculata* Porte *ex* Lem. (1863)—a native of the Philippines—was founded on a juvenile mottled form cultivated in Europe. As the mottling occurs frequently in the juvenile forms of several Pinanga palms, the species was regarded as unidentifiable. Since the species was described from living specimens cultivated in Europe, I undertook in Europe an inquiry into this subject and found that the Philippine plant cultivated there as *P. maculata* was identical with *P. Copelandii* Becc. (*Fedde, Repert.* XXXV, 1934, p. 281). The specimen that gave the most important clue to this identification was Vilmorin's specimen in Wendland's herbarium. This specimen should, therefore, be called the Apotype or Logo-Apotype of *P. maculata.*

6. TOPOTYPES and ICOTYPES:—Even when the Proterotype is characteristic, then similar specimens from the Proterotype, or even from other, localities are of great value,

especially to the herbaria that possess only imperfect material, or none at all, of the Proterotype collections. Moreover such specimens may serve to supplement the details concerning either the plant organs not represented in the original specimens, or the full range of variation in the species. Hence the need to distinguish Topotypes and Icotypes from Apotypes.

In Jacksons' Glossary, Icotypes are defined as "Types serving for identification, but not previously used in literature". According to that definition, Icotype specimens, as soon as they are cited in literature, would cease to be Icotypes and would therefore have to be relabelled—a thing not always easy to do when most botanical institutions do not have a staff enough to cope with such a work. Besides Jackson's definition would also include the Topotypes that are not used in literature. To avoid this I have modified the definition of Icotype to include only those specimens that agree with the original type though not from type localities, and irrespective of the fact that they are or are not cited in literature.

Note:—According to the status of the locality from which the Proterotype was obtained, the prefix *Topo* can be added to define the newer collections more accurately; *e.g.* Topoholotype, Topoparatype, Topolectotype, Topoapotype, etc. Similarly the prefix *Ico* will indicate the status of the type specimen with which the Icotype has been compared: *e.g.* Icoholotype, Icoparatype, Iconeotype, etc.

Example:—In the case of *Poa amboinica* L. *emend.* Retzius, discussed under Lectotype (*Example 3*), Mr. Fischer mentions, besides the specimen (the Neotype or Lectotype) in Retzius's herbarium in Lund, two other specimens of *Eragrostis amboinica* [*amboinensis*] (L.) Trin., that are preserved in the Smithian and the Natural History Museum herbaria in London. One of these specimens was collected from the Lectotype locality in South India, while the other was grown in England from the seeds collected from the same locality. Both these specimens will have to be called Topolectotype, or Toponeotype.

7. NEOTYPE:—

Example 1:—*Scirpus glaucescens* Willd. (the basinym of *Heleocharis glaucescens* Schultes) was described as having had compressed stems and trifid styles, but the only specimen with that name in Willdenow's herbarium has been identified by specialists as *Heleocharis palustris* (L.) R. and S., a species with non-compressed stems and bifid styles. Now should the specimen in Willdenow's herbarium be considered the holotype of *H. glaucescens* (Willd.) Schult? If that specimen has been correctly identified as *H. palustris,* it cannot be *H. glaucescens* (*ex* descriptione), and so one may presume that the holotype of the latter has been lost or mislaid; but, if it really has compressed stems and trifid styles, it can be taken as the holotype of *H. glaucescens.* As the type plant of *H. glaucescens* was growing in the Berlin Botanic Gardens, it is possible, that Willdenow, the director of the institution, did not preserve the actual specimen which he dissected and from which he drew his specific diagnosis, and that later, in order to fill up the gap in the herbarium, he took a specimen of what appeared to him the type plant or a plant identical with it.

Dr. O. A. Farwell (Rhodora, XXXII, 1930) shows that, excepting perhaps the one phrase *glauco-virescens,* Willdenow's description is quite applicable to *H. acuminata* (Muhl) Nees and that "his characters of *three styles* and *compressed stems* clinch the identity. No other species of the genus known to me so well fills the bill; certainly not the plants in America masquerading as *H. glaucescens,* for they have two stigmas and the stems are not compressed." If Farwell's identification of the species is correct, then the Holotype of *H. acuminata* becomes the Neotype of *H. glaucescens* (Willd.) Schultes. [But whatever may be the status of Willdenow's specimen (Pseudotype or Holotype), it is evident that Willdenow's description does not apply to *H. palustris* (L.) R. and S., and so Willdenow's species (*ex* descriptione) cannot be regarded as a synonym of the latter] (see also the *Example* under Merotype and Proteromerotype).

Example 2:—cf. *Example 3* under Lectotype.

8. IDEOTYPE:—According to Jackson's Glossary, an Ideotype is "a specimen identified by the describer, but not from the original locality", while a specimen identified by the describer from the original locality is called a *Metatype* (*-Meta* = with; after). But since a heterotype chosen or identified by an author may fall in any of the several heterotype categories, I modify this definition so that the prefix *Ideo* shall denote a heterotype identified or chosen by the author of species. Thus there could be Ideolectotype, Ideotopotype (Metatype), Ideoproteromerotype, Ideoneotype, Ideoicotype, etc.

Examples:—cf. *Example 1* under Lectotype and *Example 1* under Merotype and Proteromerotype.

9. MEROTYPE and PROTEROMEROTYPE:—For taxonomical purposes, the plant that supplied a type specimen of the species, is known as the type-plant (*vide infra,* on the labelling of Type-plants); and any specimen of this plant collected before or after the Proterotype-collection, is known as a Merotype. According to the status of the proterotype or secondary type derived from the plant, the Merotype can be more precisely described by such combinations as Meroholotype, Merolectotype, Mero-apotype, Meroneoholotype, etc. The definition of this term in Jackson's Glossary is not the same as that given by Dr. W. T. Swingle, the originator of the term, but it is applicable to Swingle's *Clonotype*—a term not included by Jackson.

If none of the original specimens studied by the author of a species was preserved, no proterotypes can exist. But a herbarium specimen from the type-plant, if collected subsequently by the author or someone else, would naturally fall into the Merotype category. In order, however, to indicate that no Proterotypes of the species exist, I distinguish as a Proteromerotype the Merotype first proposed as the standard of the species.

As, however, neither a Merotype, nor a Proteromerotype, can have entered into the original description of a species, they cannot be considered as Holotypes, Paratypes or Syntypes. For instance, take the orchids or the herbs which have been described

from living plants without preservation of herbarium material. Anyone, even the author of the species, who wished subsequently to take herbarium material from the type-plant, might have been misled into taking a specimen from the wrong plant, though somewhat similar to the one described. Now should a subsequent worker notice discrepancies between the herbarium material and the original description, the prefix Mero or Proteromero would at once put the worker on guard against the specimen. Besides, during the interval that must elapse between the taking of the original material and the Merotype, the type-plant itself may have grown more fully and have exhibited certain characteristics that were not visible in the original material and which, therefore, were not noted in the original description. In such a case, too, the prefixes, Mero and Proteromero, might prevent erroneous interpretation of the specific description and indicate the extent of the variability in the plant (*vide* also under Clastotype; and also the example under *Isotype*).

Example:—In the case of *Scirpus glaucescens* Willd., the basinym of *Heleocharis glaucescens* Schultes, mentioned in *Example 1* under Neotype, it has to be noted that the species was based on a plant growing in the Berlin Botanical Gardens. Presumably Willdenow drew his specific description from a living specimen which he did not preserve, and later he took, for his herbarium, material from a wrong plant mistaking it for the type-plant. If this surmise is correct, this second specimen should have been labelled as the Proteromerotype, or more precisely Ideoproteromerotype—a name that, had it been used by Willdenow himself, would have saved many controversies over the exact status of the species. For, as pointed out in the previous discussion of the case, (cf. under Neotype) the specimen that in Willdenow's herbarium bears Willdenow's specific name has been identified with a species (*Heleocharis palustris*) that has neither compressed stems nor trifid styles, characters which Willdenow expressly mentioned in the specific description of his *S. glaucescens*..

10. ISOTYPE:—A botanist, working critically on rare or taxonomically difficult plants, will naturally prefer to give all specimens taken simultaneously from one individual plant one field number and to the specimens taken in a similar manner from another plant another field number; even though both plants are of the same species and grow side by side, and both collections are taken on the same day and at the same hour. Now should a specimen from any of these collections become a Holotype, Lectotype, Apotype, Neotype, etc. respectively, the remaining specimens from the same collection will be of special value in any subsequent critical study of the species or to the other herbaria not possessing any of the original types, since they were all collected at one and the same time and from one and the same type-plant. Such duplicates are called by Swingle "Synchronous Merotypes", but I propose instead to restrict to them the use of the word Isotype and to call them respectively Isotype, Isoapotype, Isoneotype, etc. as the case may be. The term Isotype, although originally proposed by Wilmott in the

sense of Swingle's Merotype, has recently come to be used rather indifferently to include all duplicates herein distinguished as Merotypes, Isotypes, Haptotypes and Clonotypes. (*vide* also under Clastotype).

Example:—In order to clarify the case of Merotypes and Isotypes further, I would refer to the system organised by Dr. F. H. Endert of the Boschwezen (Forest Department) in the Netherlands Indies, in order to secure adequate herbarium material of precisely such large forest trees as are likely to be omitted by ordinary "extensive" collectors. A forest official resident in a district selects and numbers a tree which is apparently typical of a species in a division of his district. In the flowering season the tree is climbed and enough material for 5 herbarium specimens is collected. Later, when the fruit is formed, the tree is felled and from it five fruiting specimens together with timber sections are taken. Now the question arises: Should both the flowering and fruiting specimens receive the same field number? Though both collections must receive the same *tree* number, they should certainly not receive the same *field* number since they were not collected simultaneously, or, if given the same field number, then a letter or other sign should be added to distinguish them. Thus if flowering specimens bear the field No. 165, the fruiting specimens could be given the field No. 165–A.

But whether these two collections are given two different field numbers or the same tree number, or both, care should be taken to indicate that, in each collection, the duplicates are of the Iso-Class, while the fruiting specimens are *Mero*-class duplicates of the flowering specimens so that, should any of the specimens become, say the Holotype, Neotype, Apotype, or a Syntype of a species, the institutions in possession of the duplicates of the type will know exactly the relation existing between the type and the duplicates: that is, if a flowering specimen from this collection were to become say the Holotype of a species, all the other specimens from the same collection will be Isoholotypes and the specimens in fruit Meroholotypes; or vice versa, if a specimen in fruit become the Holotype, all the duplicates in fruits become Isoholotypes and the specimens in flowers Meroholotypes. (see also note under Haptotypes below).

11. HAPTOTYPES:—Collectors generally, but specially those who require to make many duplicates, cannot give as much care in preparing their duplicates as can a botanist making his Isotypes. Collectors often give the same field number to specimens collected in the same locality from a number of different plants, that is to say, from plants that appear to the collector to be conspecific, but which may not be. Now it has already been pointed out in the introductory discussion of the Varieties of Types that in some cases, as of certain palms, herbs, orchids, grasses, or fungi, such procedure may be the only means to secure specimens in sufficient quantities to make many duplicates and, at the same time, to prevent the numbering in the field from becoming excessive and valueless. In these circumstances it should not be surprising if some duplicates belong to another species than the Proterotype. When, therefore, there is no means of ascertaining whether the specimens bearing one and the same number were derived from the same individual plant (or clump in the case of tufted plants), the duplicates should be regarded with suspicion and should never be called

Isotypes. Therefore I propose the term Haptotype for such duplicates. Only a Haptotype certainly collected simultaneously from the type-plant should be called an Isotype.

Note:—Even when all the specimens of a collection have been derived simultaneously from a single clump or tuft, it is advisable to look upon the duplicates with suspicion unless such duplicates have been prepared carefully by a compètent botanist. I make this note after having noticed several discrepancies in the case of duplicates of palm specimens derived from the plants cultivated in the Botanic Gardens, Buitenzorg, Java. There the authorities in charge of the gardens aim to keep the numbering of the cultivated plants as accurate as possible; yet despite their care they are not able to prevent the seeds of one species from growing in clumps of another closely related species. In consequence one may sometimes see a clump labelled as of one species containing stems of another closely related species that has grown there from self-sown seeds.

Example 1:—In Flora Capensis V, Section 1 (1910) 246, N. E. Brown published the new species *Orthosiphon Thorncroftii* N. E. Br. with Thorncroft's specimen in Kew herbarium numbered 3123 as a syntype. Dr. Maurice Ashby, who has made this species the type (=basinym) of his new combination, *Hemizygia Thorncroftii* (N. E. Br.) Ashby, has shown that a specimen bearing this number in the herbarium of the Transvaal Museum at Pretoria does not correspond with the syntype in the Kew herbarium but represents *Hemizygia transvaalensis* (Schlecht.), Ashby (Journ. Bot. LXXIII, 1935, p. 349 adnot.).

Example 2:—Ridley gave the number 5123 to some *Dæmonorops* specimens collected from more than one clump, no doubt in the belief that these clumps were all of the same species. Subsequently he submitted one specimen to Beccari, who determined it as *D. angustifolius* Mart. Accordingly, Ridley entered this name on all the remaining duplicates of the Hapto-class numbered 5123 in the Singapore herbarium. It now appears that most of these are *D. grandis* Mart. Presumably, Ridley regarded all these duplicates as equivalent like the duplicates of Iso-class, and thus was led to misinterpret *D. angustifolius* Mart. in both his *Materials* II (1907) and his *Flora* V (1925).

12. CLONOTYPE and SPERMOTYPE:—When a type collection is small and when it is difficult to transplant the type plant to a garden, every opportunity should be taken to propagate the type-plant vegetatively or by seeds and to take duplicates from its progeny. This practice is not uncommon in many botanic gardens, though the specimens thus derived rarely bear precise labels. To be accurate a specimen from such an offspring should be labelled either a *Clonotype*, if the offspring was raised vegetatively, or a *Spermotype* if it was raised from seed or spore. These terms, Clonotype and Spermotype, are useful also because they may enable one to decide with herbarium material whether or not a variation from the type is hereditary in the species.

13. CLASTOTYPE:—Taxonomically considered, the only equivalent duplicates are Clastotypes and Isotypes. No other

duplicates can be regarded as taxonomically equivalent since they were not certainly gathered at the same time as the original type and from the same type-plant. Merotypes and Clonotypes, although they stand next in importance as duplicates, may have the disadvantage of showing marked variations from the Proterotypes and Isotypes or they may have been taken from a wrong plant owing to a mistake in the identity of the type-plant. Particular care should be taken, therefore, to prevent such important duplicates as the Clastotypes, Isotypes, Merotypes, and Clonotypes becoming mixed during drying, transit, mounting, etc. To prevent mixing, numbered tags should be attached to the larger parts of specimens, and numbered capsules should include seeds, fruits, flowers, and other small components.

4. The Labelling of Type Plants in Gardens

Botanical gardens often have type-plants or their offspring in cultivation. It would be useful if these type-plants were correctly labelled in the garden and the particulars of their history and place were kept filed in the office records. If this course were followed, the importance of the plants would become at once apparent both to the curators and visiting botanists. Besides, if the field labels of a type-plant were lost, the record file would enable one to locate the plant.

This, of course, is merely a suggestion. Each institution has its own methods, adapted to its particular requirements. The suggestion is put forward merely to indicate one way at least whereby type-plants growing in a garden might be made more useful to systematists and less liable to be forgotten. As an instance, I may point out that the seed progeny of type-plants of *Livistona Woodfordii, Ptychosperma Sanderianum* and *Borassus Machadonis* are presumably all growing in the Botanic Gardens, Singapore, but owing to inadequacy of labels and records it is extremely difficult to identify with any degree of certainty the plants that were raised from the seed directly obtained from the Holotype-plant.

As to the terminology of the type-plants one can adopt with advantage the one proposed above for labelling the type-specimens. The term Holotype, Paratype, Syntype, Lectotype, Neotype, Apotype or Ideotype, when applied to a type plant, would show the nature of the type specimen which this type-plant had supplied. Furthermore, a plant collected together with the holotype-specimen, and which is believed to be of the same species as the holotype, might be called a Haptotype plant, or more precisely a Haptoholotype-plant. The offspring of a type-plant, would also be called by the designation of their respective parents with the added prefix *Spermo* or *Clono,* according to the derivation of the offspring by sexual or asexual propagation. Finally, by adding the number of the propagation, as 1, 2, 3, etc., the exact generation of any one of the progeny

would be ascertainable at a glance. Thus "Spermoholotype 3" would mean that the plant so labelled was of the third sexual generation from the holotype plant.

5. The Labelling of Type Specimens in the Herbarium

In conclusion, I would remark on the labelling of type-specimens in the herbarium. Several botanists seem to favour strongly a tiny label with a printed inscription to indicate each kind of type, while others go further and recommend special colours for the slips, or special coloured ink for the inscriptions (one colour for each kind of type). In fact these different kinds of printed slips are many times found included with the unmounted duplicates of types (antitypes) sent in exchange from other herbaria.

To my mind these tiny slips are often nothing but a great nuisance. They are easily dislodged not only during the transit of unmounted specimens but also later when the specimens are being consulted in the herbarium, poisoned or mended. Should any of the slips fall out of a bundle, what clue is there to its right place? Should any be misplaced in the herbarium, what indication is there even for a botanist to detect the error? And one has to bear in mind that, while these slips are intended to aid the trained botanists, all the work of mounting, poisoning, mending, etc. may be entirely in the hands of persons who scarcely comprehend "all the fuss that botanists make over wee bits of printed paper", which can be had in ample quantities in the stores, and which they can hardly distinguish from the ones sent by other herbaria to indicate that a specimen has already been poisoned. Needless to say, the work of mounting and mending herbarium specimens should be rendered as simple as possible, so that, in the event of labels falling out of a packet, the right place could be found with little difficulty even by the personnel of the mounting department; or when, as sometimes happens, a label is pasted on a wrong sheet, the mistake may be recognised and corrected by anybody consulting the specimens. But reliance on printed slips, coloured or not, only introduces into such instances a most discouraging confusion; and possibly a confusion that not even the botanist himself would find it easy to straighten out, while in some instances an initial error would most certainly go undetected unless the botanist consulting the specimen were himself to undertake a revision of the species paying particular attention to its history and that of its types.

On these grounds alone there is in my opinion a serious objection to the use of tiny printed slips. Instead, the terms Holotype, Paratype, Lectotype, etc. should be written by hand on the specimen sheet itself or on the label that bears the name and number of the specimen. But there are other grounds why the simple and direct method of writing down by hand should be encouraged, when recording the status of a specimen in a

herbarium. For one thing, writing is easier and quicker than searching for the appropriate slip, which is a labour likely to discourage botanists from recording on the specimen sheet any discovery they may make regarding its relation to a published species or plate, or even the fact that it was compared with any of the existing types. For another thing, these tiny printed slips have no place for date or even the initials of the person who made the comparison or study; and in a large number of cases, as with Lectotypes, Apotypes, Neotypes, etc., for instance, it is important to know who made the selection of the Lectotype from the Syntypes, or who compared a herbarium specimen with the Holotype, etc. But if the method of writing directly by hand is adopted and even if the writer has omitted his initials, it is often easy to recognise the handwriting. On the other hand, the bare printed slip may have been put by anyone without any expert observation through a mistake: it carries on the face of it no personal guarantee. Finally, how obscure might have been the history of many a classical type-specimen in the herbaria of Linnaeus, Lamarck, Jussieu, Banks, Delessert, Retzius, Wallich, Griffith and the rest and how different the interpretation of the species now ascertained to have been based on those specimens, were it not for the handwriting of the persons who studied the types?

No doubt to preclude entries directly on the herbarium sheets by incompetent persons, there is in force in many herbaria a regulation that all annotations should be made on separate slips of paper or determination-labels to be pasted or pinned afterwards on the sheet. These labels could obviously be used also to indicate the nature of the types. As for the unmounted duplicates to be distributed, the information about their nature could be entered directly on each label that accompanies the duplicate giving particulars about its collection number, collector, locality, date, etc., though even in these cases the above mentioned determination-labels would also be far preferable to the tiny printed slips.

When recording particulars of the nature of the type on slips or determination-labels, it is advisable to head the label with the collector's name and the collection number (or, if without number, the locality and date) followed immediately by the name of the species, *e.g.*

1. Kœnig, South India
Poa amboinica L. emend. Retz.
Neolectotype. sec. Retz.
initials:
} in Retzius' Herbarium in Lund.

2. *Vilmorin, from cultivated specimens*
Pinanga maculata Porte *ex* Lem.
Logo-apotype sec. Furtado
initials: C.X.F. 15-11-33.
} in Wendland's Herbarium in Berlin.

3.	*Ridley*, 9090 Areca bongayensis Furtado sp. nov. Haptoholotype *initials:* C.X.F. 15-2-34.	in British Museum Herbarium.
4.	*Ridley, on Matang, in July*, 1903 Calamus conjugatus Furt. sp. nov. Holotype.	in Herb. Singapore.
5.	*Wallich* 4441 Raphidophora peepla (Roxb.) Schott. Neotopotype. sec. Furtado	in British Museum Herbarium.
6.	*Wallich*, 4441 *partim* Rhaphidophora peepla (Roxb.) Schott. Hapto-Neotopotype or Topotype sec. Furtado C.X.F. 18-2-34.	in Herb. Kew.

These entries will serve the double purpose of guiding the personnel of the mounting department in finding the correct sheet for a label, should it have become detached and fallen out of the specimen cover; and they will enable the systematist to detect mistakes at once should labels have been glued on wrong sheets.

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ASTERISKS IN LINNAEUS'S SPECIES PLANTARUM

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1. Introduction and Conclusions

In the *Journal of Botany*, lxxv, 1937, p. 78, Mr. T. A. Sprague and Mr. A. W. Exell have conjointly published a note drawing the attention of botanists to the significance of asterisks in Linnaeus's *Species Plantarum* ed. 1 (1753). They have shown that the use of asterisks was explained by Linnaeus himself in the following paragraph in the preface of the second edition of his work:

"DESCRIPTIONS * tantum in obscuris adhibere necessem fuit, easque sine ambagibus, ut obtinerem compendium tironibus gratum".

This paragraph, but without the asterisk, is the verbatim reprint from the first edition of Linnaeus's *Species Plantarum*. Consequently Mr. Sprague and Mr. Exell assume that the asterisk was accidentally omitted after the word DESCRIPTIONES in the first edition of the work. They translate the paragraph as follows:

"Only in doubtful cases was it necessary to cite descriptions, and those, straightforward ones, so that I might keep the handbook suitable for beginners."

While agreeing with the explanation of the omission of the asterisk from the first edition of the *Species Plantarum*, I find myself compelled to dispute this translation and, therefore, to reconsider the conclusion of these authors on the significance of the asterisk. The translation appears to me misleading, because it is too free and is removed from its context, and is therefore decidedly ambiguous. Linnaeus cited descriptions for nearly every species, but no one imagines that he considered them all doubtful. Is "compendium" really a "handbook"? And what can be meant by the indefinite phrase "doubtful cases"? Are we to suppose that Linnaeus was

doubtful of every species in the synonymy of which he employed an asterisk, or that he was merely doubtful of the unasterisked citations under it; or that he considered the citations with an asterisk to some extent doubtful though supplying a straightforward description, while those without an asterisk were not at all doubtful? It is clear that the translation of the phrase "in obscuris" and the interpretation of the asterisk may be matters of considerable taxonomic importance, for on them will depend the procedure for interpreting a Linnean species with an asterisked citation.

In view of this uncertainty I have undertaken an inquiry into the problem. My conclusions are these:

1. The paragraph should be read:

"Only in the case of obscure plants was it necessary to indicate with an asterisk such descriptions as were straightforward, so that I might keep the *compendium* suitable for beginners."

Note:—(*a*) "obscure" does not mean doubtful (*see* section 2, subsection V, p. 314). (*b*) "Compendium" means the list of synonyms or citations, *i.e.* the synopsis of the species under consideration (*see* section 2, subsection V, p. 315).

2. LINNÆUS did not mean to invest the asterisks with the force of indicators for discriminating between the synonyms (citations). The asterisks were meant as a guide for beginners, and all synonyms, whether with or without an asterisk, were equally important for the experienced botanist.

The evidence for my conclusions is set forth below.

2. Notations in the Species Plantarum

In order to view the problem of asterisks in their proper light, I have investigated the meaning of several other notations used by LINNAEUS for similar purposes. I shall therefore divide the problem under the following heads:—(i) Doubtful Taxonomic Groups; (ii) Imperfectly Investigated Taxonomic Groups; (iii) Synonyms of Doubtful Identity; (iv) Doubtfully Separable Taxonomic Groups; and (v) Species Containing Asterisked References.

Except when otherwise stated, all paragraphs and examples quoted below are from LINNAEUS'S *Species Plantarum* ed. 1 (1753), and the quotations without page references are from the preface of the same work.

i. DOUBTFUL TAXONOMIC GROUPS

LINNAEUS, in his preface to the *Species Plantarum*, informed the reader that, having himself been many times deceived by the specific descriptions given by others, he had left out of his book all species of which he could not examine actual specimens or drawings, so that what was uncertain might not get mixed

with what was known for certain. The sentence in question runs thus:

"NON VISAS plantas heic omisi, toties elusus ab auctoribus, ne dubia certissimis miscerem".

It is obvious that LINNAEUS meant by the word *plantas* not only specimens but also drawings for it is a well-known fact that LINNAEUS based several species merely on drawings. Nor is this contradicted by the fact that his previous experience in the matter of published descriptions, unsupported by drawings or specimens, led him to adopt CAESALPIN'S dictum:

"Ignoto Genere proprio nulla descriptio, *quis accurata tradita,* certam demonstrat, *sed plerumque fallit.*"

which motto LINNAEUS placed on the reverse of the title-page of his book. Nor is it contradicted by the further fact that, despite all his efforts to keep out species of which he could not examine drawings or specimens, there are evidences to show that he has not been able to ignore entirely the descriptions of his contemporaries and friends. Thus, for instance, he published an unnamed *Trientalis* (*i.e.* without a trivial name); but here he was careful to mark the reference with an obelisk (dagger) and make the following observation:

"Plantam hanc non vidi, *ex* auctoritate Clariss. D. Royeni adposui." (p. 344).

It is evident therefore that by the phrase "in obscuris" LINNAEUS did not mean dubious species (*plantæ dubiæ*), *i.e.* those that were not known to him from specimens or reliable drawings.

ii. IMPERFECTLY INVESTIGATED TAXONOMIC GROUPS

It is understandable that, in such a comprehensive work, LINNAEUS had not sufficient opportunities or material to investigate fully every one of the species which he described. He therefore indicated insufficiently investigated species with an obelisk so that others might examine them in more detail. The use of obelisks is explained in the following sentence:

"si vero aliquando contigerit non sufficienter inspexisse plantam, vel specimen imperfectum obtinuisse, signo + hoc notavi, ut alii eandem accuratius examinent."

The dagger is employed perhaps more with the purpose of directing botanists to a further inquiry into species than with the purpose of indicating his own imperfect inquiry. Thus the reference cited under the unnamed *Trientalis sp.* is, as noticed above, daggered, though LINNAEUS himself had not had any opportunity of seeing the plant. An unnamed *Phyllis sp.* (p. 232) is daggered and contains the following remarks: "Flores hujus mihi ignoti sunt", while the following species, although not

daggered, have attached to them remarks which show that LINNAEUS had imperfect specimens for examination:

(*a*) *Cassia javanica* p. 239: "Flores mihi non protulit".

(*b*) *Laurus Winterana* p. 371: "Flores ipse non vidi'".

(*c*) *Eranthemum capense* p. 9: This is not daggered neither in the first edition nor in the second edition of *Species Plantarum*, but the second edition contains the following note: "Habitus *Chironiæ*, unicum specimen minus perfectum vidi, ideoque accuratius examinanda."

The cases are very few where the species containing asterisked references also contain remarks to show the species were imperfectly investigated, and so far I have come across only one species where both an obelisk and an asterisk occur (*i.e. Ammi glaucifolium* p. 243).

I conclude from this that the phrase "in obscuris" does not refer to such cases as were imperfectly investigated by LINNAEUS.

iii. SYNONYMS OF DOUBTFUL IDENTITY

That LINNAEUS did not generally allow himself to be guided by descriptions alone, unaccompanied by specimens or drawings, has been explained above. It is therefore to be presumed that he did not cite any synonyms of which he had not examined drawings or specimens. Further it is to be presumed that LINNAEUS did not give each and every synonym, even when its type specimen or drawing was available for inspection. On the title-page of *Species Plantarum*, LINNAEUS speaks of *Synonymis Selectis* and, in the following paragraph of the preface, he informs readers, of the reasons that led him to give more synonyms to non-European plants than to the European plants:

"SYNONYMA paucissima in EUROPÆIS plantis adhibui, contentus *C. Bauhino & Iconographo* præstantiore; in EXOTICIS vero plura, quum difficiliora minusque trita sint."

But despite this selection of synonyms, LINNAEUS had cases where he was not sure of the correctness of his determination of them; and such synonyms he has shown with a question mark. Such queried references have, in my opinion, to be excluded in typifying a Linnean species.

Examples of queried references will be found under *Apluda mutica* p. 82, *Aristida adscensionis* p. 82, and *Queria canadense* p. 90.

There are, however, cases like *Alpinia racemosa* (1753) p. 2 and (1763) p. 2, which contain references that are queried not in the first edition of the work, but only in the second. But these references stand on a different footing and should be included in typifying a Linnean species.

It is evident that the phrase "in obscuris" and asterisks do not refer to the synonyms of whose identity LINNAEUS had still doubts.

iv. Doubtfully Separable Taxonomic Groups

From time to time it happens that an author cannot decide whether certain taxonomic groups should be separated as species, quite distinct from others, or should be subordinated to other groups. Linnaeus himself made a point of indicating under each species or variety any such uncertainty. And that Linnaeus did not use the asterisks to indicate such uncertainty is obvious because, firstly, most of the species accompanied by asterisked references have no remarks about uncertainties; and secondly, most of the species having such remarks bear no asterisked references. But the conclusive evidence that "in obscuris" and asterisks do not refer to this kind of uncertainty is the fact that Linnaeus established several monotypic genera accompanied by asterisked references to the type species but without remarks throwing doubts upon the status of the type species. And what makes this evidence so strong against the view that "in obscuris" relates to such uncertainty on the part of Linnaeus, is that the work of Linnaeus is not such as to lay him open to the charge of inconsistency in having established a new genus without being sure of the only species included under it.

(*a*) *Examples of Species containing remarks but no asterisks:*

1. *Prunus sibirica* p. 474: "An hæc satis distincta a precedenti?"
2. *Cistus pilosus* p. 528: "Hæ tres. α. β. γ. vel varietates vel valde affines certiora determinent autoptæ".
3. *Asarum canadense* p. 442: "An varietas præcedentis; sic suadent Folia bina; dissuadent alia".
4. *Hyacinthus monstrosus* p. 318: "An sequentis sola varietas?"
5. *Leontice Leontopetaloides* p. 313: The diagnosis is obelisked, and the remarks are as follows: "Habitus hujus generis, at flos videtur satis diversus, an sufficienter pro distincto generi determinent autoptæ."
6. *Sanicula canadensis* p. 235: "Structura ita præcedentis, ut vix differentia, sed planta decupulo sæpe omnibus partibus major."
7. *Gentiana campestris* p. 231: "Præcedenti nimis affinis & fere varietas aut hybrida."

(*b*) *Examples of Species in monotypic genera containing asterisked references:*

Maranta arundinacea p. 2; *Eranthemum capense* p. 9; *Amethystea cærulea* p. 21; *Muntingia calabura* p. 509; *Nama zeylanica* p. 226; *Heliocarpus americana* p. 448; and *Gethyblis afra* p. 442.

Each of the last two species contains one reference, which is to the type specimen itself. There is no diagnosis independent of this reference, yet one finds this only reference is marked with an asterisk.

v. Species Containing Asterisked References

I submit that the foregoing discussion has made it amply evident that the phrase "in obscuris" does not refer to any cases when Linnaeus had doubts either about a species, or about a description, or about a synonym.

Looking therefore to the accepted meanings of the word *obscurus* I find that they can be divided into two classes: The first is original and objective "obscure, not manifest to the eye, difficult for observation" *i.e.* the object itself present some difficulties, which come in the way of one's seeing it clearly or of discriminating between its various parts; the second class is figurative and subjective and refers to the difficulties experienced in getting to know about the object or forming a definite opinion about the status of the object. Difficulties (or obscurities) of the first class affect the apprehension of the characters of the thing observed, even when the observer has full opportunity to examine it; those of the second class arise from insufficiency or inaccessibility of material or from inability to comprehend the characters already apprehended. Difficulties of the second class were dealt with by LINNAEUS in the four different procedures discussed above. I surmise therefore that LINNAEUS used the word *obscurus* to express not his own doubts, but the obscurities, intricacies, or difficulties which the species themselves presented to an observer. LINNAEUS has used the word *obscurus*, or its derivative, in such a sense in the following note under *Cistus apenninus* p. 529: "Cistorum historia maxime omnium obscura ob varietatum copiam, illustrabitur si determinent in singulis——————".

Now in order to determine what sort of objects or cases are implicit in the phrase "in obscuris", it is necessary to consider the entire paragraph with reference to the one immediately preceding it. The two paragraphs are:

"SYNONYMA paucissima in EUROPÆIS plantis adhibui, contentus C. *Bauhino & Iconographo* præstantiore; in EXOTICIS vero plura, quum difficiliora minusque trita sint.

"DESCRIPTIONES * tantum in obscuris adhibui necessum fuit, easque sine ambagibus, ut obtinerem compendium tironibus gratum."

From this context it appears that the word *plantis* is understood after "in obscuris", so that we get actually three consecutive sentences where the words *planta* and *adhibere*, or their derivatives, occur or are understood, *viz.*:

1. Synonyma paucissima in Europæis plantis adhibui,————
2. In Exoticis [plantis] plura [synonyma adhibui]————
3. Descriptiones tantum in obscuris [plantis] adhibere necessum fuit————.

This preceding paragraph also explains the word "compendium" as referring to the "synonyma". It can hardly be translated as "handbook" because four paragraphs earlier LINNAEUS referred to his work as "Libello" with a capital letter ("compendium" is written with a small letter). Further the original meaning of the word "compendium" is "a hanging together" and its immediately derived meaning is "a putting together" with the idea of effecting a saving, and therefore "a shortening". Now LINNAEUS put together the synonyms

under each species and effected a saving in space by not quoting all the descriptions given by other authors. Hence I maintain that word "compendium" is employed by LINNAEUS to mean rather the "compendium synonymorum" (putting together the previously described species in a synoptic form) than a shortening of descriptions or of his book (as Mr. SPRAGUE and Mr. EXELL imply), of which LINNAEUS did not speak. But whether "compendium" is translated as I suggest here or whether it is translated as "handbook", the interpretation of the significance of asterisks and of the signification of the phrase "in obscuris" remains unaffected.

In view of the foregoing reasons I suggest that the entire paragraph containing the phrase "in obscuris" might be best translated as follows:

"Only in the case of obscure plants was it necessary to indicate with an asterisk such descriptions as were straightforward, so that I might keep the *compendium* suitable for beginners".

This means that LINNAEUS asterisked references only in the case of species that presented difficulties for observers or investigators, the object of asterisks being to lighten the task of beginners by directing them primarily to straightforward descriptions. Other references LINNAEUS left unasterisked not because there was any doubt as to their identity or status, but either because the plants were not obscure or not difficult to study, or because the descriptions in cited references were thought to be not straightforward.

From this it follows that asterisks were not intended by LINNAEUS to indicate any distinction between diagnoses or synonyms and descriptions, as Mr. SPRAGUE'S and Mr. EXELL'S note seems to suggest; nor do the asterisks indicate that LINNAEUS considered the descriptions given in *Species Plantarum* merely diagnoses, or inadequate descriptions. LINNAEUS himself gave long descriptions even when he had asterisked some references, as can be seen from the following examples:

Cerbera manghas p. 208; *Leontice thalictroides* p. 312; *Vaccinium frondosum* p. 351; *Origanum syriacum* p. 590; *Gerardia purpurea* p. 610; *Malva tomentosa* p. 687; *Trifolium tomentosum* p. 771; *Hyoseris virginica* p. 809; *Carduus helenioides* p. 825; and *Cacalia suaveolens* p. 835.

The majority of references asterisked are from LINNAEUS'S previous works, but other references also have been asterisked, even to RHEEDE'S *Hortus Malabaricus* (*e.g. Curcuma rotunda* p. 2), though descriptions from this last work are usually regarded as "obscure" by modern botanists. Further if two or more references are found to contain straightforward descriptions of one and the same synonym LINNAEUS asterisked both the references (*e.g. Eranthemum capense* p. 9, *Euphorbia Cyparissias* p. 461). There are also instances where references that are not asterisked in the first edition of *Species Plantarum*, are marked with asterisks in the second edition (*e.g. Justicia adhatoda* and

J. ecbolium, ed. 1 p. 15 and ed. 2 p. 20). The probable reason for this is that the marks were inadvertently omitted in the first edition of the work, or that LINNAEUS did not realize at the time either how "obscure" was each of the species, or how straightforward were the descriptions.

This view of the asterisks in LINNAEUS'S *Species Plantarum* makes the interpretation of asterisked references clear, not only in cases where they are the only references given under a genus or species (references which may be considered as the sole basis of the genus or species) and in cases where a lengthy description is given as well, but also in the case of *Ammi glaucifolium* p. 243, which has a reference marked with both an obelisk and an asterisk. Similarly this view enables us to understand why under *Valeriana tripteris* p. 32, not only the reference to Bauh. Prodr. p. 86 (specially noted by Mr. SPRAGUE and Mr. EXELL), but even other references given under the same species, are not asterisked; or why the only reference given in *Grislea secunda* p. 348 or in *Allophyllus zeylanicus* p. 348 is asterisked, while that in *Gethylis afra* p. 442 or in *Heliocarpus americana* p. 448 is not, though in each case the reference is to a Linnean work, and the species is the type of a monotypic genus and is not accompanied with a diagnosis or a description.

PUBLICATIONS OF THE BOTANIC GARDENS, SINGAPORE

1. **The Agricultural Bulletin of the Malay Peninsula** [Old Series] nos. 1–9, 1891–1900 (out of print).

2. **The Agricultural Bulletin of the Straits and F.M.S.** [Second Series, monthly issues] Vols. 1–10, 1901–1911. Most numbers are available, price 50 cents each or $5 per volume.

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THE

GARDENS' BULLETIN

STRAITS SETTLEMENTS

Vol. IX 31st March, 1938 Part 4

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THE

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Vol. IX 31st March, 1938 Part 4

NOTES ON MALAYAN DIPTEROCARPACEÆ—IV*

By C. F. Symington,

Forest Research Institute, Kepong

This paper deals with rather a motley collection of species. In the first place I have tackled certain problems that have arisen in the course of preliminary botanical study in anticipation of wood-technological work on *Dipterocarpus* and *Hopea* from the Malay Peninsula. Thanks to the good work of Dr. van Slooten, the botany of *Dipterocarpus* is in reasonably good order, and with the notes here supplied on *D. gracilis* Bl. and *D. chartaceus* Sym. there is not much more essential critical work to be done on our species at this stage. With *Hopea* we are less fortunate. In this paper I have tackled one of the major problems connected with *H. Pierrei* and other species in the section *Dryobalanoides*, but there is yet much to be done in this rather difficult section of the genus.

Next I have given a note on the *Richetia* group of *Shorea*, the object of which is to bring together a group of species of obvious natural affinity. This involves the transfer of several species of *Balanocarpus* to *Shorea*, with concommitant name changes. I regret the necessity for these changes, but it *is* a necessity, and my apologies should rather be for not having made the changes sooner.

A problem that is becoming more evident and pressing with increasing knowledge is that of the delimitation of specific and lesser groups. If, for example, we consider only the species occurring on the west side of the Malay Peninsula, we find the specific limits are on the whole clearly defined, and the variations within a species are insufficiently constant to suggest the presence of definable sub-species, varieties, or other forms. Were we to extend our investigation to the whole of the Malay Peninsula,

* For previous papers see *Gard. Bull. S.S.* Vol. VII, pp. 129–159 (1933) and Vol. VIII, pp. 1–40 (1934) and 265–292 (1935).

things would not be quite so simple and, were the whole possible range of distribution of our dipterocarps considered, the delimitation of species would become a very acute problem. For example, there are several dipterocarps in Brunei that, on the usual morphological evidence, are clearly much more closely related to certain Malay Peninsula species than to any other described forms. Yet in some character or characters, possibly vegetative ones usually considered of little importance, they do differ distinctly and constantly. Should these Brunei trees be considered as species distinct from their Malay Peninsula counterparts; as varieties, forms, or some lesser groups; or are the differences so slight as to be unworthy of definition? These are obviously questions which can be adequately answered only in the light of very extensive knowledge of concepts and variations of groups within the family; premature decisions are likely to necessitate undesirable alterations in the future. Some problems with practical issues involved, however, cannot be postponed indefinitely, and one such problem, concerning *Shorea assamica*, is tackled in this paper.

The problem of specific definition arises again in this paper in connection with *Parashorea malaanonan* and its variety here described as var. *tomentella*. *P. malaanonan* introduces another matter of general interest, conveniently described as "the treatment of doubtful interpretations". For example, I am faced with deciding whether or not to accept Merrill's interpretation of Blanco's *Mocanera malaanonan*. I do not consider Merrill was justified in his interpretation, but the evidence is insufficient to prove him wrong. In the circumstances, and because the name *Parashorea malaanonan* is now well established in botanical and forestry literature, it seems desirable to accept Merrill's interpretation. But the position cannot be considered satisfactory, and it seems appropriate here to plead with those who undertake interpretations of this nature to treat the names as *nomina dubia* or *nomina ambigua* unless the evidence is incontrovertible.

The description of new species from Borneo, commenced in the last paper of this series, is continued here, the following species being described and figured—*Shorea acuminatissima*, *S. xanthophylla*, *S. sandakanensis*, and *S. Smithiana*.

The paper is concluded with a description of *Vatica diospyroides* (one of several interesting new dipterocarps from Dr. Kerr's Siamese collections) and a note on two dipterocarps collected by the Oxford University Exploration Club in Borneo but omitted from the collection submitted to me in 1934 (*vide Gard. Bull. S.S.* 8: 1).

I should like to thank the many botanists and forest officers who have continued to give me their valued assistance and co-operation. I am also indebted to the Director of the Bureau of Science, Manila who afforded me the opportunity of studying

the Philippine collections of dipterocarps during a visit to Manila in December 1935, and to the Director of the Royal Botanic Gardens, Kew who again extended to me the hospitality of the Herbarium during my leave in 1936.

Dipterocarpus gracilis Bl., Bijdr. V, 224 (1825); V.Sl. in Bull. Jard. Bot. Buitenz. III, 8: 276 (1927). *D. pilosus* Roxb. (1832) sensu Parker in Ind. For. Rec. 13: 15 (1927), non sensu Brandis in Journ. Linn. Soc. (Bot.) 31: 28 (1895). *D. vernicifluus* Blanco, Fl. Philip. ed. 2, 314 (1845). *D. Skinneri* King in Journ. As. Soc. Beng. 62, pt. 2: 91 (1893); Ridl., Fl. Mal. Penins. 1: 214 (1922); V. Sl. in l.c. 294; Foxw., Mal. For. Rec. 10: 70 (1932) var. hirtus Ridl. excl.. *D. angustialatus* Heim in Bot. Tidsskr. 25: 43 (1903); Fischer in Kew Bull. 1926: 457.

In my endeavour to decide upon the correct name for the tree we have known in the Malay Peninsula as *Dipterocarpus Skinneri* I find it impossible to distinguish our tree from that known in Burma, the Andamans, and Siam, as *D. pilosus,* and from the tree known as *D. gracilis* in the Netherlands Indies and the Philippines.* *D. pilosus* has been considered systematically by Parker and *D. gracilis* by van Slooten, both in 1927. These authors were working simultaneously on different territorial regions and neither has indicated that union of the two species might be necessary, although Parker united *D. Skinneri* King with his *D. pilosus,* and van Slooten drew attention to the similarity of *D. Skinneri* King and *D. gracilis* Bl. Moreover, prior to publication of Parker's work, the identity of *D. pilosus* Roxb. was, as van Slooten (l.c., p. 274) rightly points out, entirely problematical, although Brandis and some other authors considered it to be identical with *D. Baudii* Korth. Parker's interpretation of Roxburgh's *D. pilosus* is based on field investigation and a process of elimination. His arguments are very reasonable, but one cannot overlook the fact that the plant he calls *D. pilosus* does not entirely fit Roxburgh's, admittedly brief and inadequate, description. I should prefer to consider Roxburgh's *D. pilosus* as a *nomen dubium,* but as I am solely concerned at present with finding a name for the Malay Peninsula tree formerly known as *D. Skinneri,* a decision on this point is immaterial. I am satisfied that our tree is specifically identical with Parker's *D. pilosus* and with *D. gracilis* Bl. as interpreted by van Slooten. Blume's name has precedence, even if *D. pilosus* sensu Parker is *D. pilosus* Roxb., because Roxburgh's name was not validly published until 1832, seven years after *D. gracilis* Bl.

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* *D. vernicifluus* Blanco is the more common name in Philippine literature, but this species was united with *D. gracilis* Bl. by van Slooten in 1927.

Dipterocarpus chartaceus Sym. **nom. nov.** *D. Skinneri* var. *hirtus* Ridl., Fl. Mal. Penins. 1 : 215 (1922); V.Sl. in Bull. Jard. Bot. Buitenz. III, 8 : 295 (in nota sub D. Skinneri). *D. Skinneri* sensu Ridl., op. cit. 214 quoad Curtis 3734; sensu Foxw., Mal. For. Rec. 10 : 70 (1932) partim; non D. Skinneri King.

Ridly first drew attention to this species when he segregated from his specimens of *D. Skinneri* a collection from Pahang (C.F. 3195), describing it as *D. Skinneri* var. *hirtus*. He failed, however, to recognize Curtis 3734 from Province Wellesley as the same form, citing it under *D. Skinneri*. In 1927 van Slooten drew attention to the fact that these two specimens were identical, and expressed the opinion that they should not be considered as a form of *D. Skinneri* King but as a distinct species. But in 1932 Foxworthy took the view that *D. Skinneri* was a variable species and included both the typical form and Ridly's var. *hirtus* under the one name.

I am returning to van Slooten's conception of Ridley's *D. Skinneri* var. *hirtus*, considering it worthy of specific rank. This species is undoubtedly very closely related to *D. Skinneri* King (= *D. gracilis* Bl.), but in several respects it is quite distict. The fruit wings in *D. chartaceus* are relatively broader and more distinctly 3-nerved than in *D. gracilis*, the fruit lobes are much smaller, the leaf is broader and has fewer nerves, and the texture of the leaves and twigs is distinct. In *D. chartaceus* the hairs are longer, sparse and deciduous, the mature leaf being almost glabrous, shining on both surfaces, and of a brittle papery texture : in *D. gracilis* the undersurface of the leaf is covered with stellate hairs usually forming a close tomentum.

As the name *Dipterocarpus hirtus* has already been employed I am renaming this species *D. chartaceus;* a name descriptive of the peculiar leaf texture.

Collections examined : —

PENINSULAR SIAM : For Dept. Siam *s.n.* (10.5.20). Kerr 12245, 14324, 15693, 18250.

MALAY PENINSULA :

Perlis : C.F. 40828.
Province Wellesley : Curtis 3734.
Kelantan : C.F. 29028.
Pahang : C.F. 3195 (Auth. spec. of *D. Skinneri* var. *hirtus* Ridl.), 6650, 15645, 24546, 29601, 40416, 40683, 40686, 40705.
Negri Sembilan : C.F. 24352.
Johore : C.F. 17089 (?)

A form of *keruing*, widely distributed in the Peninsula although not abundant, has been known by the name of *D. Skinneri*. The opinion is here expressed that this is the

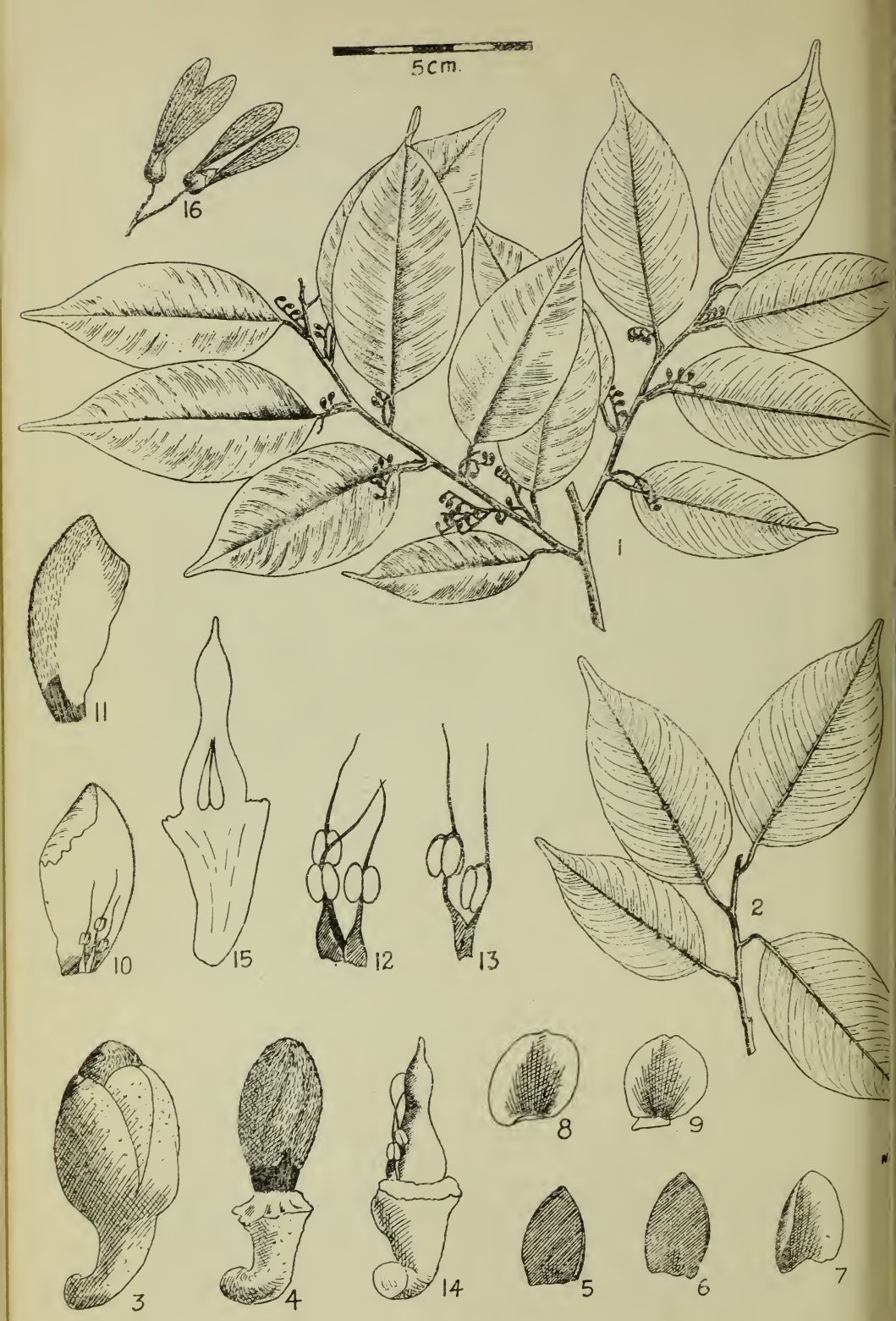

Plate 17. *Hopea Pierrei* Hance.

same species as that known by the name of *D. pilosus* in Burma and *D. gracilis* in the Netherlands Indies and the Philippines. The species are united and the oldest name *D. gracilis* Bl. is adopted in place of our *D. Skinneri*.

Another rather rare form of *keruing* was described by Ridley in 1922 as *D. Skinneri* var. *hirtus*. It is considered that this variety is worthy of specific rank and it is renamed *Dipterocarpus chartaceus* Sym.

Hopea Pierrei Hance in (Lond.) Journ. Bot. 15: 308 (1876) et 329 (1877); Brandis in Journ. Linn. Soc. (Bot.) 31 : 67 (1893) Pl. 2, fig. 10, quoad speciminum cambodiorum; Dakkus in Bull. Jard. Bot. Buitenz. 3, Suppl. 1 : 162 (1930); non Hopea Pierrei sensu Ridl., Fl. Mal. Penins. 1 : 238 (1922); non sensu Foxw., Mal. For. Rec. 10 : 133 (1932); non sensu auct. philip. (1909–1937). "*Hopea micrantha*?" Hance in l.c. : 242, non H. micrantha Hook. f.. *Hancea Pierrei* Pierre, Fl. For. Cochinch. 16 (1891) t. 248 (in tabula antem Hopea Pierrei). **Plate 17.**

Pierre's description and drawing of *Hopea Pierrei* are excellent, while his remarks concerning the diagnostic characters separating it from *Hopea Griffithii* Kurz, *H. micrantha* Hook. f., *H. Beccariana* Burck, and *H. microptera* Dyer (= *H. Dyeri* Heim) bear evidence of careful study, and should have been sufficient to obviate the mistakes of subsequent authors. The tree, as I know it from the Malay Peninsula, agrees entirely with Pierre's description except that I have not noted any marked development of adventitious stilt roots. This, however, is a variable character in the section *Dryobalanoides*. The most useful diagnostic characters are the short petiole, the midrib sunk on the upper surface, the numerous but faint main nerves, the bottle-shaped ovary and stylopodium, and the glandular outer sepals. The presence of domatia in the axils of the lower nerves is variable.

This species was first discovered in the island of Phu Quoc in Cambodia and tentatively identified by Hance in 1776 with *Hopea micrantha* Hook. f. Shortly afterwards, however, he named the species *Hopea Pierrei*. In 1891 Pierre described and figured the species (under *Hancea*) in considerable detail, basing his observations on specimens numbered 1425 in his herbarium which are, presumably, those examined by Hance.

Subsequent misinterpretation of Hance's species has resulted in *Hopea Pierrei* being recorded from Borneo, the Philippine Islands, and the Malay Peninsula, on false evidence. In 1895 Brandis added Borneo and Singapore to the distribution of the species on the evidence of Becc. 2504 and 3050 from Borneo, and a collection of Ridley's from Singapore. A consideration of leaf characters alone makes it quite clear that Beccari's

collections are not *H. Pierrei* Hance. In that species the midrib is depressed above but in the Bornean collections it is distinctly raised. I consider that the latter are *H. Dyeri* Heim. I am not sure to what specimen of Ridley's Brandis refers when recording *H. Pierrei* from Singapore, but in all probability it was one of the two Kew sheets of *H. Griffithii* Kurz from that locality.

In 1922 Ridley continued to record *H. Pierrei* from the Malay Peninsula but his citations appear (it is difficult to identify the specimens with certainty as no numbers are cited) to include four distinct species none of which is *H. Pierrei* Hance. Quite erroneously he gives *H. intermedia* King as a synonym of *H. Pierrei* Hance.

Foxworthy, who continued to record *H. Pierrei* from the Peninsula, had a different conception of the species from either Brandis or Ridley. The specimens he cites are, with the exception of King 3525 and Holmberg 820 (which may be *H. Dyeri* Heim), all *H. pedicellata* (Brandis) Sym. (*see* p. 327).

Hopea Pierrei Hance, however, does occur in the Peninsula, although Brandis, Ridley, and Foxworthy have all recorded it as a result of mistaken identification. The earliest collection from the Peninsula was a sterile specimen (C.F. 3950) from Bentong District of Pahang collected in 1919. It is represented only in the Kepong herbarium and until now has been unidentified. Since 1930 several additional collections have been made by the Forest Department, at Bukit Raka in Bentong District of Pahang and at Ulu Gombak in Selangor. Unfortunately only one of these has flowers, but comparison of this with Pierre's specimen shows that it has all the distinctive vegetative and floral characters of *H. Pierrei* Hance.

I have already stated that I consider Brandis wrong in recording *H. Pierrei* Hance from Borneo. The species has also been recorded from the Philippine Islands, from 1909 onwards, as a result of mistaken identification. I shall not here attempt to unravel the confusion under the name of *H. Pierrei* in the Philippine literature but, having examined, as far as I know, all the material concerned, I can say definitely that none is *H. Pierrei* Hance. Actually I think seven different species have, from time to time, been included under the one name. Among these are specimens of *H. malibato* Foxw. and *H. Foxworthyi* Elmer (Syn. = *H. glutinosa* Elmer), but the remainder are probably undescribed.

Hopea Pierrei is found in cultivation in the Botanic Gardens, Buitenzorg.

Collections examined :—

CAMBODIA: Pierre 1425 (Auth. spec. of *Hopea Pierrei* Hance); Guibier No. 2; Foxworthy No. 8.

SIAM : Chantaburi; Kerr 9176: N. Rabil 14.

Plate 18. *Hopea Beccariana* Burck.

MALAY PENINSULA :
PAHANG : C.F. 3950, 38023, 38035.
SELANGOR : C.F. 23645, 36632, 37292, 37296, 37297.
JAVA : (Cult.) Hort. Bog. VII—B—58.

Hopea Pierrei Hance is a form of *merawan* which was described originally from Cambodia. Brandis, Ridley, and Foxworthy, have recorded this species from the Malay Peninsula, but investigation shows that they have applied the name *Hopea Pierrei* to the wrong trees. It is here shown, however, that true *Hopea Pierrei* does occur in the Peninsula, although its known distribution is limited to two localities, Bukit Raka near Bentong and Ulu Gombak in Selangor.

Hopea Beccariana Burck in Ann. Jard. Bot. Buitenz. 6: 240 (1887); Brandis in Journ. Linn. Soc. (Bot.) 31 : 68 (1895); Sym. in Gard. Bull. 8 : 28 (1934) in obs. *Hancea Beccariana* Pierre, Fl. For. Cochinch., t. 248 (1891) in nota sub H. Pierrei. *Hopea Nicholsoni* Heim in Bull. Soc. Linn. Paris, 2 : 293 (1891). *Hopea intermedia* King in Journ. Asiat. Soc. Beng. 62 : 126 (1893) et in Ann. Bot. Gard. Calcutta 5, pt. 2 : 156, Pl. 189A (1896) pro maiore parte; Brandis in l.c. 67, partim; Foxw., Mal. For. Rec. 10 : 134 (1932); Durant, Rep. Forests Brunei; 40 (1932); Burkill, Dict. Econ Prod. Mal. Penins. : 1190 (1935); non H. intermedia sensu Foxw., Mal. For. Rec. 3 : 74 with 2 plates (1927). *Balanocarpus ovalifolius* Ridl. in Journ. F.M.S. Mus. 10 : 130 (1920) pro maiore parte; non B. ovalifolius sensu Foxw., Mal. For. Rec. 10 : 143 (1932). *Hopea Pierrei* sensu Ridl., Flor. Mal. Penin. 1 : 238 (1922) partim, non H. Pierrei Hance et sensu auct. **Plate 18.**

This species is adequately described under *H. intermedia* by Foxworthy (*Mal. For. Rec.* 10 : 134). I would comment, however, that the stamens are definitely 15 in number and that a stilt-root habit does frequently develop in old trees. As remarked by many authors this species is similar to *H. Pierrei* Hance in flower structure. *H. Pierrei,* however, differs markedly in having glandular sepals, in the shorter petiole, and in the midrib of the leaf which is sunk above as opposed to raised in *H. Beccariana.*

Hopea Beccariana was founded by Burck on one of Beccari's Bornean collections (1177) which has leaves and immature fruits. Four years later Heim described an almost identical Beccarian collection (2761) as *H. Nicholsoni.*

A tree which I consider to be the same species was collected on Penang Island by Curtis, and described by King in 1893 as *H. intermedia.* King cited three collections when describing the species—Curtis 425 and 1398, and Kunstler 3709 (Perak). The last is certainly another species and its citation here may

have been partly responsible for subsequent confusion. However, from the excellent figure published by King in the *Ann. Bot. Gard. Calcutta,* there can be no doubt which species King had in mind as *H. intermedia.*

Brandis followed King but made some original suggestions as to the affinities of the species. He suggested that *H. intermedia* might be established as con-specific with *H. Pierrei* Hance, a suggestion upon which Ridley acted in 1922 when he united the two species. Brandis was certainly correct in drawing attention to the similarity in floral anatomy, but vegetatively these species are so distinct that there can be little justification for the union. Brandis also erroneously cited Curtis 1397 under *H. intermedia:* it is *H. pedicellata* Sym. (*see* p. 327).

Ridley's conception of *H. Pierrei* is very confused. His citations include, besides several collections of *H. Beccariana,* those of at least two other species none of which is *H. Pierrei* Hance. (Ridley has also cited some collections of *H. Beccariana* under *H. micrantha*). In 1920 Ridley described *Balanocarpus ovalifolius* from a flowering collection of *H. Beccariana* (Haniff 3727). He cited also Curtis 426, which had tentatively been placed under *Balanocarpus latifolius* by Brandis, but this is actually a sterile collection of seedling leaves of *Shorea Maxwelliana* King. Ridley's *B. ovalifolius* has since been misinterpreted by Foxworthy.

It is clear from the Plates in *Mal. For. Rec.* 3 that in 1927 Foxworthy's conception of *H. intermedia* was not that of King but in 1932 this misconception was corrected, although a few wrongly determined collections have been included in the specimens cited.

We now have ample flowering and fruiting material of *H. Beccariana* from the Malay Peninsula, but from Borneo, the type locality, only Beccari's original specimens with young fruits and some recent sterile collections exist as far as I know. It may, therefore, seem somewhat rash to unite *H. intermedia* King (the Peninsula form) with *H. Beccariana* Burck, but the vegetative characters of this tree, in particular the long petiole, make it distinct from most related forms. Moreover we have additional support for the union in field and wood characters.

Collections examined :—

MALAY PENINSULA : PENANG : Curtis 425,* 1938 (Auth. specs. of *H. intermedia* King), s.n.; S'pore 3460, 3474, 3721, 3727 (Auth. spec. of *B. ovalifolius* Ridl.), 9140; C.F. 2552, 8149, 9661, 10802, 11218, 11673, 11678, 11731, 27783, 28029, 28051.

KEDAH : C.F. 8906, 11467, 17776, 21920.

* There has been some confusion in the labelling of some of the sheets in the Singapore Herbarium : there are four sheets of *H. Beccariana* and two of *H. pedicellata* all labelled Curtis 425.

Plate 19. *Hopea pedicellata* (Brandis) Sym.

KELANTAN : C.F. 37811.
PERAK : Ridl. s.n. (Feb. 1891), C.F. 3413, 11040, 14384, 14387, 17066, 27822, 28594, 31075.
DINDINGS : C.F. 5001, 5007, 9857, 16574, 16599, 27844.
SELANGOR : C.F. 30148, 32854, 37290, 40762, 40970.
PAHANG : C.F. 8149, 27971, 37319, 42932.
NEGERI SEMBILAN : C.F. 23670, 24292, 26636, 43543.
MALACCA : Goodenough 1447; C.F. 41552.
JOHORE : C.F. 1199, 5852, 5863.

BORNEO : SARAWAK : Becc. 1177 (Auth. spec. of *H. Beccariana* Burck) and 2761 (Auth. spec. of *H. Nicholsoni* Heim).
BRUNEI : C.F. 28662, 30611, 37052, 37121.
BRITISH NORTH BORNEO : Villamil 38 (?)

Hopea Beccariana, the *merawan batu* of our *List of Botanical and Vernacular Equivalents*, is a common tree on ridges in hilly jungle on Penang Island, the Dindings, and elsewhere throughout the Malay Peninsula. It has coarsely fissured bark, a tendency to become stilted, and frequently produces prolific regeneration. The identity of the tree has not been very well understood but it has usually been given as *Hopea intermedia* King. *Hopea intermedia* King is here considered to be conspecific with *H. Beccariana* Burck described from Borneo and the latter name is adopted for our *merawan batu*.

Hopea pedicellata (Brandis) Sym. **comb. nov.** *Hopea micrantha* sensu King in Journ. Asiat. Soc. Bengal 62, pt. 2 : 124 (1893) partim; sensu Ridl., Fl. Mal. Penins. 1 : 237 (1922) partim; non H. micrantha Hook. f.. *Hopea Griffithii* var. *pedicellata* Brandis in Journ. Linn. Soc. 31 : 69 (1895) specimina sumatrana exclusa; Ridl. in op. cit. 238, in nota sub H. Pierrei. *Hopea intermedia* sensu Brandis in l.c. 67 quoad Curtis 1397, non H. intermedia King. *Hopea mengarawan* sensu Brandis in l.c. 70 quoad King 8170, non H. mengarawan Miq.. *Hopea Pierrei* sensu Ridl., op. cit. 238, partim; sensu Foxw., Mal. For. Rec. 10 : 133 (1932) et ex Burkill, Dict. Econ. Prod. Mal. Penins. 1193 (1935), pro maiore parte; non H. Pierrei Hance. **Plate 19.**

As Brandis' original description of this species under *Hopea Griffithii* var. *pedicellata* is inadequate and other descriptions have been confused by the inclusion of other species, I have prepared the following—

Branchlets grey or purple-black, often conspicuously lenticellate, usually puberulous towards the ends but later glabrous. *Leaves* lanceolate or oblong-lanceolate, caudate-acuminate at the apex, rounded or acute and occasionally subcuneate at the base, usually about 6.5 × 2.5 cm. to 11.0 × 4.25 cm., glabrous on both surfaces except for the midrib which

is usually puberulous above, drying yellow-brown on both surfaces but usually paler on the upper; midrib raised on both surfaces, puberulous above, prominent and glabrous beneath; main nerves about 13 to 16 pairs, fine and parallel, inarching at the leaf margins, frequently furnished with small tufted domatia in their axils, between each are 1 to 3 slightly shorter intermediary nerves parallel to them; main and intermediary nerves faintly visible and slightly sunk on the upper surface, visible as faint yellow lines on the smooth under-surface; reticulations invisible to the naked eye; petioles 0.8 to 1.2 cm. long, sub-terete, dark and glabrescent or fulvous tomentose; stipules minute, caducous. *Panicles* axillary towards the tip of the branchlets or terminal, of solitary or paired racemes, 3.0 to 4.0 cm. long at most, glabrous or very sparsely puberulous; ultimate branchlets of raceme 5.0 to 10.0 mm. long, each bearing 3 to 5 secund flowers about 1.5 mm. apart. *Flowers* sub-ovate in bud, pedicellate, about 4.0 mm. long (including the pedicel); pedicel about 1.0 mm. long (not thickening gradually towards the sepal bases as in some related species), glabrous and drying black. *Sepals* broadly ovate, shortly blunt acuminate, glabrous on both surfaces, sparcely papillose outside. *Petals* linear-oblong, usually blunt, tomentose on the portion exposed in bud, white to creamy yellow in throat of corolla (Symington). *Stamens* normally 15 (13 and 16 have been counted), the inner row of 10 sub-equal, the outer row (epistaminous on alternate stamens of the inner row) smaller; filaments broad at the base narrowing rather abruptly about the middle to the filamentous upper portion; anthers oval, 4-celled, the anterior cells almost as large as the posterior; appendage to connective filiform, about as long as the filament and anther. *Ovary* and stylopodium broadly cylindrical, slightly constricted below the stylopodium, truncate at the top; style erect cylindrical, about as long as the stylopodium, stigma minute. *Fruit* glabrous on all parts; stalk small but conspicuous, about 1.0 mm. long; two long wing-like accrescent sepals spathulate, blunt, about 4.5 × 0.8 cm., thick and woody at the base, chartaceous on the free portions, about 7-nerved; three small sepals, rotundate, about 0.7 cm. high, rather woody; nut embraced in the lower half by the closely appressed imbricate sepals or sepal bases, ovate-conical, about 10.0 × 6.0 mm., shining, more or less covered with a thin coat of resinous cement, crowned with a short sharp apicula (persistent style).

The species here named *Hopea pedicellata* is common on the hills of Penang and in parts of Perak. It was first mentioned in botanical literature in 1893 when King referred four collections in flower (167 and 1397) and fruit (266 and 8170) to *Hopea micrantha* Hook. f., a species described from Borneo. Having examined all the relevant herbarium material I agree with Brandis in considering King's identification to be wrong. Superficially the two species are extremely alike but, as Brandis

points out, the characters of the stylopodia are distinct—in *H. micrantha* the ovary is surmounted by a cylindrical style but in *H. pedicellata* there is a thick truncated stylopodium.

Although Brandis detected the mistaken identification of King he does not appear to have had a very clear conception of the species himself; he cites one specimen (Curtis 1397) under *H. intermedia,* one (King 8170) under *H. mengarawan,* and on a third (Curtis 167) he founded his *H. Griffithii* var. *pedicellata.* The description of this variety is very brief—*"Pedicels nearly as long as calyx. Branches of inflorescence puberulous in the Sumatran specimens"*—and the citations are—Penang (Curtis 167), Sumatra (Forbes 3205, 3208). The Sumatran specimens differ so considerably from Curtis 167 both in vegetative and flower characters that I do not think they can be considered as the same species; I am restricting Brandis name, therefore, to the Penang specimen.

In describing this species as a variety of *H. Griffithii* Kurz, Brandis has evidently been mainly influenced by the similarity in stylopodium. I consider, however, that, in view of the marked differences in other characters, the two plants should be kept specifically distinct.

In 1922 Ridley referred a specimen (presumably Curtis 1397, Govt. Hill, Penang, 1200 feet altitude) of this species to *H. micrantha* Hook. f. but concerning Curtis 167, upon which Brandis' *H. Griffithii* var. *pedicellata* is founded, he says *"it is just possible that it is a hybrid between* H. Pierrei and H. micrantha".

In 1932 Foxworthy described *H. pedicellata* as *H. Pierrei** but the differences are so considerable that there seems no justification for doing so. (See also notes under *H. Pierrei*).

Collections examined :—

PENINSULAR SIAM : S'pore 24205.

MALAY PENINSULA : Penang : Curtis 167 (Auth. spec. of *H. Griffithii* Kurz var. *pedicellata* Brandis), 266, 425, 1397, 1405, s.n.; S'pore 3475, 3732, 3770, 9137; C.F. 11679, 27790, 28032.

Perak : King 8170; C.F. 25562, 25635, 25874, 28083, 28994, 28995.

Kelantan : C.F. 37667 (?)

Trengganu : C.F. 26913.

On the hills on Penang Island there are two common species of *Hopea* known as *merawan.* One is a smooth-barked tree with marked stilt roots, while the other (our *merawan batu*) has fissured bark and is not markedly stilted. There has been much confusion concerning the botanical identity of these trees. On

* King 3525 and Holmberg 820 should be excluded from the citations in *Mal. For. Rec.* 10 : 134.

pp. 325–327 the fissured-barked tree is investigated and it is shown that it should be known as *Hopea Beccariana* Burck, while in the above note it is concluded that the smooth-barked tree should be called *Hopea pedicellata* (Brandis) Sym.

The Richetia Group

I have referred in these *Notes on Malayan Dipterocarpaceæ* I and II to the very close relationship existing between certain species of *Shorea* and *Balanocarpus* and in the latter paper (p. 27) I have identified the wingless-fruited members of this group with Heim's genus *Richetia*. Similarly the winged-fruited members may be identified with Heim's section *Richetioides* of *Shorea*. There is, however, no essential difference between *Richetia* and *Richetioides* and there are species with rudimentary wings which bridge the apparent gap between them. Lumped together they form a natural group which, for convenience, I refer to as the *Richetia* group.

The Malay Peninsula species of this group have been enumerated by Desch (*Mal. For. Rec.* 12: 37) whose wood-anatomical examinations entirely support my grouping based on external morphological characters. I therefore feel that there can no longer be any justification for maintaining some members of this group in *Balanocarpus* and some in *Shorea* and am here referring all the species to *Shorea*. The name-changes involved are these—*Balanocarpus multiflorus* (Burck) Sym. in Gard. Bull. S.S. 7 : 153 (1933) becomes **Shorea multiflora** (Burck) Sym. **comb. nov.**; *Balanocarpus coriaceus* (Heim) Brandis in Journ. Linn. Soc. 31 : 112 (1895) becomes **Shorea Richetia** Sym. **nom. nov.**; *Balanocarpus pahangensis* Foxw., Mal. For. Rec. No. 10 : 145 (1932) becomes **Shorea balanocarpoides** Sym. **nom. nov.**; *Balanocarpus maximus* King in Journ. Asiat. Soc. Bengal 62 : 133 (1893) becomes **Shorea maxima** (King) Sym. **comb. nov.**; and *Balanocarpus longiflorus* (Brandis) Foxw. ex Sym. in Gard. Bull. S.S. 8 : 29 (1934) becomes **Shorea longiflora** (Brandis) Sym. **comb. nov.**

To the *Richetia* group I assign the following species—*Shorea Faguetiana* Heim, *S. hopeifolia* (Heim) Sym., *S. multiflora* (Burck) Sym., *S. balanocarpoides* Sym., *S. blumutensis* Foxw., *S. gibbosa* Brandis, *S. Richetia* Sym., *S. kalunti* Merr., *S. resina-negra* Foxw., *S. maxima* (King) Sym., and possibly *S. longiflora* (Brandis) Sym. The last three, however, are in some respects atypical. Several hitherto undescribed Bornean species, including *S. xanthophylla* Sym. and *S. acuminatissima* Sym. described in this paper, also belong to the *Richetia* group.

The diagnostic anatomical, morphological, and field characters, of the group are many, but I shall defer enumeration of them until the undescribed members have been more fully studied. One important point I should like to record here is

that all species have 2-celled anthers. Foxworthy described *S. resina-negra* as having 2-celled anthers, but I cannot find any other record of this condition in other members of the family, nor in family or generic diagnoses.

I have referred to this group of species somewhat noncomittally as the "*Richetia* Group". It will, of course, be necessary to assign to it a definite botanical rank such as genus, subgenus, section, or subsection, but I leave such assignation until a time, not too far distant I hope, when a reliable taxonomic treatment of the genus *Shorea* will be produced. Considered purely from a botanical standpoint there can be little doubt that the *Richetia* group merits generic rank, and there are other groups within the genus, *e.g.*, sections *Eushorea* Brandis and *Anthoshorea* Brandis, that could also quite legitimately be so treated. A similar condition exists in the genus *Hopea*. Let us hope, however, that if and when these genera are next monographed, full consideration will be given to the claims of those whose interest in the trees concerned is mainly from the utilization standpoint. It is alarming to contemplate the effects of a revision in nomenclature of the *Dipterocarpaceæ* under a narrow generic conception, but as this can quite conveniently be avoided by the creation of sub-genera rather than genera, it is to be hoped that this latter method of treatment will be followed.

Shorea assamica Dyer forma **assamica** Sym. **stat. nov.** *Shorea assamica* Dyer in Hook. f., Fl. Brit. Ind. 1 : 307 (1874); Brandis in Journ. Linn. Soc. 31 : 85 (1895), et Ind. Trees. 70 (1911); Foxw. in Philip. Journ. Sc. (Bot.) 4 : 516 (1909); Troup, Ind. Woods and Uses 241 (1909), et Silv. Ind. Trees 133 (1921); Gamble, Man. Ind. Timb. 83 (1922); Pearson et Brown, Commerc. Timb. Ind. 1 : 119 (1932); Parkinson in Ind. For. Rec. (Bot.) 1 : 40 (1937).

forma **philippinensis** (Brandis) Sym. **stat. nov.** *Shorea philippinensis* Brandis in l.c. (1895) 88; Foxw. in op. cit. 6 : 272 (1911) partim, et 13 : 190 (1918); Merr. Enum. Philip. Flow. Pl. 3 : 98 (1923). "*Shorea sp. aff. S. Harmandii Pierre,*" Foxw. in op. cit. 6 : 272 (1911). *Shorea pallida* Foxw. in op. cit. 13 : 190 (1908).

forma **Koordersii** (Brandis) Sym. **stat. nov.** *Vatica celebica* Koorders, Mss. in Herb. Koord. (1895). *Shorea Koordersii* Brandis ex Koorders in Meded. 'S Lands Plant. 19 : 355 (1898); Icon Bogor. 1, Tab. 80 (1901); Heyne, Nutt. Plant. Ned. Ind. edit. 1, 3 : 303 (1917) et edit. 2, 2 : 1120 (1927); Endert in Korte Meded. Bosch. 51 (Tectona 28 : 288) 1935.

forma **globifera** (Ridl.) Sym. **stat. nov.** *Shorea globifera* Ridl., Fl. Mal. Penins. 1 : 232 (1922); Foxw., Mal. For.

Rec. 3 : 35 (1927), et 10 : 191 (1932); Sym. ex Desch, Mal. For. Rec. 12 : 27 (1936). **Plate 20.**

I have here united under one specific head four "species"—*S. assamica* Dyer (from Assam), *S. philippinensis* Brandis (from the Philippines), *S. Koordersii* Brandis (from Celebes), and *S. globifera* Ridl. (from the Malay Peninsula). Having examined a considerable amount of material of each I do not think that specific differentiation of these forms is justified, but there are certain fairly constant definable minor differences such as one would expect in distinct geographical races of a widely distributed species. I have, therefore, recognized four forms—forma *assamica* (from Assam and Burma), forma *philippinensis* (from the Philippines), forma *Koordersii* (from Celebes and the Moluccas), and forma *globifera* (from the Malay Peninsula and Sumatra).

There has been comparatively little systematic confusion in this species. The form *assamica,* the first to be described, was collected in Assam and described by Dyer as *S. assamica* in 1874. This form has since been collected also in Upper and Lower Burma and Tenasserim.

The form *philippinensis* was first described from Luzon by Brandis in 1895 as *S. philippinensis,* but this form does not appear to have been very clearly understood in the Philippines. In 1911 Foxworthy cited under *S. philippinensis* several collections of other species, and he listed three authentic collections under the heading of "*Shorea sp.* aff. *S. harmandii* Pierre". These last three were made the basis of a new species, *S. pallida* Foxw., in 1918 but this was rightly reduced to *S. philippinensis* by Merrill in 1923.

The form *Koordersii* was described as *S. Koordersii* by Brandis in 1898 from collections from North Celebes. Brandis drew attention to the similarity between this and his *S. philippinensis,* and even suggested their possible specific union when more material of the latter was available.

The Malay Peninsula form, forma *globifera,* was described by Ridley from fruiting material as *S. globifera* in 1923. In 1932 Foxworthy added a description of the flowers. This form has since been collected in Sumatra by Yates.

The various forms have been fairly adequately described under the names of *S. assamica, S. philippinensis, S. Koordersii,* and *S. globifera,* but concerning Foxworthy's description of the flowers of the last-named, I would remark that I have been unable to verify the presence of more than 15 stamens, the species being typical of the section *Anthoshorea* Brandis.

In the following Key the main differences between the forms are enumerated.

Plate 20. *Shorea assamica* Dyer forma *globifera* (Ridl.) Sym.

(1) Branchlets of raceme usually simple, solitary, and alternate; stigma distinctly 3-partite; fruit wings up to about 10.0 cm. long; appendage to connective about 1½ times as long as the anther ..... forma *assamica*

(1) Branchlets of raceme frequently bi-furcate or fascicled

(2) Stigma usually distinctly 3-partite; fruit wings up to about 10.0 cm. long; appendage to connective as long as the anther .....forma *globifera*

(2) Stigma simple, flattened, or obsurely lobed; fruit wings up to about 7.0 cm. long; appendage to connective about twice as long as the anther ..... (3)

(3) Leaves usually closely peltate and smooth beneath ..... forma *Koordersii*

(3) Leaves usually sparsely soft-stellate-hairy beneath ..... forma *philippinensis*

Collections examined :—

ASSAM (forma *assamica*) : G. Mann s.n. (Auth. spec. of *S. assamica* Dyer), G. Mann *s.n.* 1883, G. Mann *s.n.* 1890; H. C. Hill *s.n.*; Hole 33; Simmons *s.n.*; A. Das 10652; U. Kanjilal 3414; For. Dept. Assam 13115 and *s.n.* 10.12.36.

BURMA (forma *assamica*) : E. M. Buchanan *s.n.*; S. M. Toppin 6019; Sukœ 2239, 7956; Parkinson 1 and 317.

MALAY PENINSULA : (forma *globifera*) : KEDAH AND LANGKAWI : C.F. 7658, 7675, 7738, 11775, 12217, 12218, 12222, 12227, 20735, 27892, 33176.

KELANTAN : C.F. 32744, 32745, 32746, 32808, 32809, 33266, 33269, 33270, 33430.

PERAK : C.F. 3072, 8308, 10369, 12983, 12985, 16349, 16706, 27226, 29866, 29894, 29924, 31038, 38103, 39070, 39071, 39223, 41613.

TRENGGANU : C.F. 24282.

PAHANG : C.F. 4027, 4052, and 5073 (Auth. specs. of *S. globifera* Ridl.); C.F. 797, 856, 20345, 29398, 29998.

SUMATRA (forma *globifera*) : Yates 1264, 1675.

PHILIPPINE ISLANDS (forma *philippinensis*) : LUZON : Vidal 983 (Auth. spec. of *S. philippinensis* Brandis); Bur. For. 12996 (Auth. spec. of *S. pallida* Foxw.); Bur. For. 6068, 7084, 13924, 17158, 17643, 17652, 22290, 23471, 27007.

MINDANAO : Elmer 14175; For. Bur. 24331, 25021, 27710, 31281.

BASILAN : For. Bur. 18887; Bur. Sc. 15418, 16102.

CELEBES AND MOLUCCAS (forma *Koordersii*) :

MINAHASA : Herb. Koord. 16734*β* and 16735*β* (*V. celebica* Koord. ms.); 15982*β*, 16737*β*, 16739*β*, 16742*β* and 16796*β* (Auth. specs. of *S. Koordersii* Brandis).

TALIABU : Herb. Bog. 362.

PULAU BISA : Herb. Bog. 54 and 55.

Pulau Obi Herb. Bog. *s.n.*

The species which we in Malaya have been accustomed to call *Shorea globifera* is here recognized as a geographical race of a remarkably widely-distributed species occurring from Assam to the Moluccas. This species has been described separately in several different localities—as *S. assamica* in Assam, *S. globifera* in the Malay Peninsula, *S. philippinensis* in the Philippines, and *S. Koordersii* in Celebes. These are here united under the oldest specific name *S. assamica* but the various geographical races, which do exhibit slight differences, are recognized as *formæ*, or forms, the former specific epithets being retained to describe them. Thus our *S. globifera* Ridl. (meranti pipit) becomes *Shorea assamica* Dyer forma *globifera* (Ridl.) Sym.

Parashorea malaanonan (Blanco) Merr., Spec. Blanco. 271 (1918), et Enum. Philip. Flow. Pl. 3 : 100 (1923); V.Sl. in Bull. Jard. Bot. Buitenz. III, 8 : 375 (1927) et ex Merr., Plant. Elmer. Born. 202 (1929). *Mocanera malaanonan* Blanco, Fl. Philip. 858 (1837). *Dipterocarpus malaanonan* Blanco, op. cit. ed. 2 : 312 (1845) et ed. 3, II : 214 (1878). *Shorea malaanonan* (Blanco) Bl., Mus. Bot. Lugd.-Bat. 2 : 34 (1852); De Candolle, Prod. 16, pt. 2 : 631 (1868); Brandis in Journ. Linn. Soc. 31 : 103 (1895); non S. malaanonan sensu Merr. et Rolfe in Philip. Journ. Sci. (Bot.) 3 : 115 (1908), et sensu Foxw. in Philip. Journ. Sci. (Bot.) 6 : 270 (1911). *Parashorea plicata* Brandis in l.c. 104 (1895); Merr. et Rolfe in l.c. 114 (1908); Foxw. in l.c. 280 (1911), et in l.c. 13 : 194 (1918); Whitford, Philip. Bur. For. Bull. 10 : 63, tab. 60 & 61 (1911). *Parashorea Warburgii* Brandis in l.c. 105 (1895); Foxw. in Leafl. Philip. Bot. 6 : 1954 (1913) et in Philip. Journ. Sci. (Bot.) 13 : 194 (1918); Merr. in l.c. 100 (1923). **Plate 21.**

Parashorea malaanonan, if the interpretation here accepted is correct, first appeared in botanical literature in 1837 under the name of *Mocanera malaanonan* Blanco. Blanco's description, which was not materially amended in subsequent editions of his *Flora de Filipinas*, is translated as follows—

Leaves ovate-lanceolate, broad, frequently pointed, whitish on the under surface. Calyx divided almost to the base in 5 oblong segments which are slightly contorted over the fruit: the 3 outer segments longer and measuring about 3 inches. Corolla ..... Stamens ..... Nut oval, free when ripe, surrounded by the calyx, with delicate (fragile) shell crowned by the long style which bears 3 stigmas, unilocular and one-seeded, the seed with 3 or 4 lobes.

Large trees, known in Angat by the possibly equivocal name of malaanonan: the leaves are a "jeme" in length, wide, and*

* A "jeme" is the length of span between the tips of extended forefinger and thumb, *i.e.* about 8 in. or 20 cm.

Plate 21. *Parashorea malaanonan* (Blanco) Merr.

whitish and smooth (soft) beneath when young. This character sufficiently distinguishes the species from others in the genus. The tree also yields on aromatic resin, but in very small quantities.

Blanco neither cited nor left a type specimen. In the second and third editions of his work the name is changed to *Dipterocarpus malaanonan*. In 1852, in a conspectus of Malaysian species, Blume changed the genus to *Shorea*. He cited no specimen, and it would appear that he saw none but considered that the species described by Blanco, whatever it was, must be a *Shorea*. At that time the genus *Parashorea* was unknown and Blanco's description is essentially that of a *Shorea*, except that he says that the nut is free when ripe. Similarly De Candolle, in 1868, and Brandis, in 1895, enumerated *Shorea malaanonan*, but they made no attempt to tie this name down to any extant herbarium material.

The genus *Parashorea* was described by Kurz in 1870, the species enumerated being *P. stellata* from Burma and *P. lucida* from Sumatra. In 1895 Brandis added two new species from the Philippines, *P. plicata*, based on flowers and young fruits, and *P. Warburgii*, based on ripe fruits evidently picked from the ground.* He did not suspect that either, or both, of these might be the plant he enumerated as *Shorea malaanonan* (Blanco) Bl.

Merrill and Rolfe were the first to attempt to identify *Mocanera malaanonan* Blanco with existing herbarium material. In 1908 they identified Blanco's description with a species described by Vidal in 1883 as *Shorea polita*, citing a number of Philippine collections. The only supporting argument for this interpretation is the statement *"we are of opinion that the above specimens are referable to Blanco's species and accordingly his specific name is accepted, Vidal's Shorea polita being here reduced."* The numerous discrepancies between their plant and Blanco's description are not explained.

This interpretation of Merrill and Rolfe remained in current use in Philippine literature until 1918 when Merrill himself, in his *Species Blancoanæ*, rejected it. In this work he states—*"I am now convinced that this interpretation was erroneous; that* Shorea polita *is a valid species entirely distinct from* Mocanera malaanonan *Blanco; and that Blanco's species is identical with the common and widely distributed Philippine* Parashorea plicata *Brandis. Among all the Philippine Dipterocarpaceæ,* Parashorea plicata *Brandis is the only one that agrees with Blanco's description in the characters of the leaves, whitish beneath, which are further described as wide, pointed, and a "geme" (i.e. 15 to 18 cm.) long, while the pericarp of the fruit is described*

* *P. plicata* Brandis and *P. Warburgii* Brandis were united by Merrill and Rolfe in 1908, and by Foxworthy in 1911. In 1913 and 1918 Foxworthy, and in 1923 Merrill, separated them again, but in 1927 Van Slooten, with whom I am in agreement, reunited them.

as fragile. The description conforms to Parashorea plicata, *and I have not the slightest hesitation in adjusting the synonymy. The native name cited by Blanco,* malaanonan, *is valueless in interpreting the species, as it is a made up one, literally "false-anonang",* anonang = Cordia myxa *Linn., and, as used to-day, is very loosely applied, although I have specimens of* Parashorea plicata *Brandis from Laguna Province, Luzon, bearing this name".* Merrill cited an Illustrative Specimen No. 1053.

I agree with this second interpretation of Merrill's to this extent—*Parashorea plicata* Brandis answers more closely to Blanco's description of *Mocanera malaanonan* than does any other *known* Philippine dipterocarp. Nevertheless, Blanco describes the fruits as having a persistent style with three stigmas and wings only 3 in. long. These characters cannot be reconciled with *Parashorea plicata* and, had I been faced with the original interpretation of *Mocanera malaanonan,* I should certainly have regarded it as a *nomen dubium.* But in deference to the fact that van Slooten and others have accepted Merrill's second interpretation, and because there certainly is not adequate evidence to prove that he was wrong, it seems desirable to allow this interpretation to stand.

The first adequate description of *Parashorea malaanonan* Merr. is that published by van Slooten in 1927. This is a very satisfactory description of the species as I know it except concerning the leaves, of which van Slooten says *"the undersurface felt-like to the touch by an usually hardly visible stellate tomentose brownish indumentum, which may have a more or less intensely greyish-white hue especially in young leaves and in leaves of saplings, along the midrib and nerves, however usually finely adpressed pubescent, afterwards on the whole undersurface often glabrous or nearly so .....".* I am inclined to think that this gives a wrong impression of the immature leaves, as I have examined some specimens, obviously immature, which are almost entirely glabrous. Indeed it is possible that some of the specimens with tomentose leaves examined by van Slooten are not typical *P. malaanonan* but what I have described (*vide* p. 338) as *P. malaanonan* variety *tomentella.* The tomentose specimens concerned, which Dr. van Slooten has kindly communicated to me, are unfortunately all sterile and I do not think it is possible to say more at present than that they are referable either to *P. malaanonan* Merr. or *P. malaanonan* Merr. var. *tomentella* Sym. A careful field investigation of mature and immature stages of both forms will be necessary to decide the point.

Collections examined :—

BORNEO : Brunei : C.F. 30531.

British North Borneo : Villamil 20 (?); Elmer 21122 (H.B. 937.26.15), 21739 (H.B. 937.26.17); For. Dept. B.N.B.

No. 1; Wood 2266 (H.B. 937.26.1); C.F. 36722 (S.H. 3922), 38727 (S.H. 4351), 38738 (S.H. 4362), 38777 (S.H. 4401), 38833 (S.H. 4457), 39019 (S.H. 4643), 41065 (S.H. 4720), 41088 (S.H. 4951), 41122 (S.H. 5979).

PHILIPPINE ISLANDS:* MINDANAO: Warburg s.n. (Auth. spec. of *P. Warburgii* Brandis); Elmer 14066 (H.B. 937.26.23); Baker 6282; Bur. Agri. 356 (H.B. 937.26.19) (?); For. Bur. 9182, 11560, 12355, 24328, 27471, 27646, 27720, 29420.

NEGROS: Bur. Sc. 1144 and 1616; For. Bur. 11194, 11244, 11646 (H.B. 937.26.25), 12314, 13755, (H.B. 937.26.26), 17418, 17488, 22677 (H.B. 937.26.30), 29466, 29467, 30127.

PANAY: For. Bur. 17838, 22567, 22569.

LEYTE: Wenzel 711, For. Bur. 11635 (H.B. 937.26.24), 12624, 12769.

BILIRAN: Bur. Sc. 18489 and 18992.

SAMAR: For. Bur. 21077 (H.B. 937.26.22) and 25934.

MASBATE: Bur. Sc. 1673; For. Bur. 12570 and 12591.

CATANDUANES ISLAND: For. Bur. 6679.

POLILLO ISLAND: Bur. Sc. 10282.

LUZON: Vidal 76, 990, and 2033 (Auth. specs. of *P. plicata* Brandis); 1053 (Illustrative specimen of *P. malaanonan* Merr. in *Spec. Blanco.*: H.B. 937.26.21); Loher 113, 114, 14770; Elmer 17695 (H.B. 937.26.20); Bur. Agri. 51, 104 (H.B. 937.26.18), 291; Bur. Sc. 1461, 2660, 3289, 11944, 12274; For. Bur. 4528, 5754, 10010, 10016, 10059, 10071, 10176, 10404, 10500 (H.B. 937.26.27), 10502, 10506, 10584, 10603, 10668, 10703, 10739, 11520, 12775, 14338, 15438, 17629, 20251, 20711, 21196, 21412, 21694, 21717, 22249, 22250, 22346, 22634, 23771, 29819.

The following specimens may be either *P. malaanonan* Merr. or *P. malaanonan* var. *tomentella* Sym.:—

BORNEO: SOUTH EAST BORNEO: Endert 5165 (H.B. 937.26.14); bb. 10848 (H.B. 937.26.9), bb. 11286 (H.B. 937.26.10), bb. 11661 (H.B. 937.26.16), bb. 12119 (H.B. 937.26.12), bb. 12145 (H.B. 937.26.11), bb. 18888 (H.B. 937.26.2); bb. 18892. (H.B. 937.26.3), bb. 18899 (H.B. 937.26.4), bb. 18903 (H.B. 937.26.5), bb. 19131 (H.B. 937.26.6), bb. 19144 (H.B. 937.26.8), bb. 19149 (H.B. 937.26.7).

BRITISH NORTH BORNEO: Elmer 21194 (H.B. 937.26.16).

PHILIPPINE ISLANDS: MINDANAO: Hutchinson 7563 (H.B. 937.26.28).

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*Some of the specimens listed from the Philippines are apparently from seedling or sapling trees. The identification of such specimens should be considered as tentative. Unfortunately, when examining the specimens I failed to list which had mature leaves and which immature.

Luzon: For. Bur. 6047, 10221 (H.B. 937.26.29), 14936, 29347.

Parashorea malaanonan (Blanco) Merr. var. **tomentella** Symington, **var. nov.,** "*Parashorea* sp.", A. V. Thomas in Mal. Forester 4: 131 (1935) partim; Sym. ex Desch, Mal. For. Rec. 12: 33 (1936). **Plate 22.**

Parashorea malaanonan (Blanco) Merr. forma typica valde affinis, a qua foliis subtus tomentosis, stylis appendicibusque brevioribus differt.

Branchlets pale fulvous-tomentose, finally becoming dark and glabrescent, annular stipular scars conspicuous. *Leaves* ovate to elliptic-lanceolate, acute or bluntly acuminate at the apex (the apices of nearly all the leaves of my specimens are damaged), rounded or sub-cordate (occasionally acute at one side) and more or less unequal at the base, very variable in size from about 8.0 × 3.0 cm. to 24.0 × 13.0 cm. or more, glabrous and shining above, covered with a pale fulvous felt-like tomentum beneath, ridges between the main nerves sometimes conspicuous; midrib slightly elevate in the lower portion on the upper surface, prominent beneath; main nerves about 12 to 16 pairs, inconspicuous above, prominent beneath; nervules join the main nerves in fine wavy sub-parallel lines; petioles 1.5 to 2.5 cm. long, thick, rugose, tomentose; stipules caducous (not seen), leaving annular scars. *Panicles* terminal or in the upper leaf-axils, racemose, lax, pale cinereous- or fulvous-tomentose, about as long as the leaves; ultimate branchlets about 3.0 to 6.0 cm. long, somewhat zig-zag, 2 to 6-flowered. *Flowers* sub-secund, 1.0 to 1.5 cm. apart in mature panicles, subtended by caducous bracteoles leaving prominent scars, about 14.0 mm. long in mature bud, about 3.5 cm. across when expanded, usually said to be white (occasionally creamy yellow). *Sepals* pale close-tomentose on both surfaces; three outer oblong-obtuse; two inner ovate-acuminate, very slightly shorter. *Petals* oblong-obtuse, pale tomentose outside and along one edge inside. *Stamens* 15, in three rows, the inner row of 5 slightly taller than the other rows which are sub-equal; filaments short, flattened, broad at the base, narrow above, occasionally furnished at the sides with a few fine hairs; anthers oblong, about 3 times as long as the filaments, sagittate at the base, cells pointed at the apex the two inner slightly shorter than the outer; appendage to connective awl-shaped, thick at the base, about one half to as long as the anther. *Ovary* ovate-conical, tapering gradually into the cylindrical style; style about as long as the sepals in mature flowers, tomentose on the lower half, glabrous above; stigma minute, flat. *Fruit* a 5-winged nut (mature fruit not seen); stalk short or almost absent, stellate hairy; bases of accrescent calyx lobes shortly united to embrace the lower third of the nut, also stellate hairy; three outer calyx

Plate 22. *Parashorea malaanonan* var. *tomentella* Sym.

lobes linear-oblanceolate or spathulate, rounded at the apex, about 14.0 cm. long and 1.5 to 3.0 cm. broad, 9 to 12-nerved, sparsely hairy; two inner lobes linear-acute, about 3.0 to 7.0 cm. long and up to 6.0 mm. broad but usually much narrower, 3 to 6-nerved; nut (immature) pale tomentose, surmounted by the long style which is glabrous on the upper portion.

Recent study of the timber commonly known as "Borneo white seraya" has necessitated botanical investigation of the identity of the tree, or trees, producing it. It was generally assumed that the main source of the timber was a single botanical species, *Parashorea malaanonan* (Blanco) Merr. Sterile botanical material, authenticating two logs (from different trees) used for pilot tests was thought by me (*vide* Thomas, in *l.c.*) to belong to the same species, although the specimens differed considerably in leaf indumentum. The subsequent receipt at Kepong of numerous collections of fertile material of *Parashorea* from British North Borneo led me to suspect that these specimens represent two distinct, possibly specifically distinct, forms. Examination of flowering collections confirms this suspicion. The smooth-leaved collections are *Parashorea malaanonan* (Blanco) Merr. and those with tomentose leaves. I am naming *P. malaanonan* var. *tomentella*. The main differences between these two forms are as follows—

P. malaanonan—mature leaves smooth and usually glaucescent on the undersurface; style long, exceeding the sepals, tomentose on the lower third only; appendage to connective longer than the filament and anther.

P. malaanonan var. *tomentella*—mature leaves covered with a close, pale, fulvous, stellate tomentum; style not or hardly exceeding the sepals of mature flowers, tomentose on the lower half; appendage to connective less than half the length of, to as long as the anther.

I have resisted a strong temptation to describe this tomentose form as a new species. If one considers the recent collections of *Parashorea* from British North Borneo alone, the two forms appear in sharp contrast and there would appear to be little justification for not recognizing two distinct, but closely related, species. Further, Mr. Keith informs me that specific separation would be justified, from a consideration of field characters. There are, however, several collections (unfortunately all sterile), mainly from South East Borneo but some from British North Borneo, Mindanao, and Luzon, which appear to be intermediate between the two. These collections are listed as "either *P. malaanonan* Merr. or *P. malaanonan* var. *tomentella* Sym." on p. 338. In 1911 Foxworthy (in *Philip. Journ. Sci.* (*Bot.*) 6 : 281) cited some of these collections from British North Borneo and

from Luzon, referring to them as a form of *Parashorea plicata* "*which is pubescent on the young twigs and on the undersides of the leaves*". In 1927 van Slooten cited Elmer 21194 from British North Borneo and several collections from South Borneo under *Parashorea malaanonan*, considering that they represented a juvenile form of the leaves of that species.

These specimens I have segregated from either *P. malaanonan* or the variety *tomentella*. As I have remarked on p. 337, further field investigation is required to decide their status, and when this decision is made the question of raising *Parashorea malaanonan* var. *tomentella* to specific rank should be reconsidered.

Collections of *P. malaanonan* var. *tomentella* examined:—

BRITISH NORTH BORNEO: C.F. 38745 (S.H. 4369) (Type of *P. malaanonan* var. *tomentella* Sym.); Otik; Kabili Forest Reserve, Sandakan, level land; 23rd March, 1935; flower. Field notes—"vern. name, *urat mata;* tree 150 feet high, 65 in. girth; flower white".

For Dept. B.N.B. No. 2; C.F. 36673 (S.H. No. 3896), 38687 (S.H. 4310), 38726 (S.H. 4350), 38734 (S.H. 4358), 38845 (S.H. 4469), 38854 (S.H. 4478), 38871 (S.H. 4485), 38935 (S.H. 4559), 38972 (S.H. 4596), 41061 (S.H. 4712), 41064 (S.H. 4719), 41087 (S.H. 4950), 41289 (S.H. 7154), 41332 (S.H. 7197).

The main source of the commercial timber called "Borneo white seraya" has been generally supposed to be a single botanical species, *Parashorea malaanonan*, which is known in the jungle in British North Borneo as *urat mata*. Two forms of *urat mata* have, however, been recognized—one with smooth leaves and the other with tomentose leaves. The botanical identity and status of these forms is here investigated, and it is shown that only the smooth-leaved form is *Parashorea malaanonan* in the strict botanical sense. The form with tomentose leaves is described as a variety of *P. malaanonan*— var. *tomentella*. It is considered that this variety may be worthy to rank as a distinct species but further investigation, particularly of immature stages in the field, is required to decide the point.

Shorea acuminatissima Symington, **sp. nov. Plate 23.**

S. Faguetianæ Heim valde affinis, sed ramulis novellis ferrugineo-tomentosis et foliis caudato-acuminatis infra scabriusculis distincta.

Branchlets densely or sparcely ferruginous-tomentose when young, later terete, glabrous, and dark. *Leaves* ovate- or oblong-lanceolate, caudate-acuminate at the apex, rounded or sub-acute at the base, margins slightly revolute, about 7.0 × 2.5 cm. to 17.0 × 6.0 cm., glabrous and drying yellow- or red-brown above,

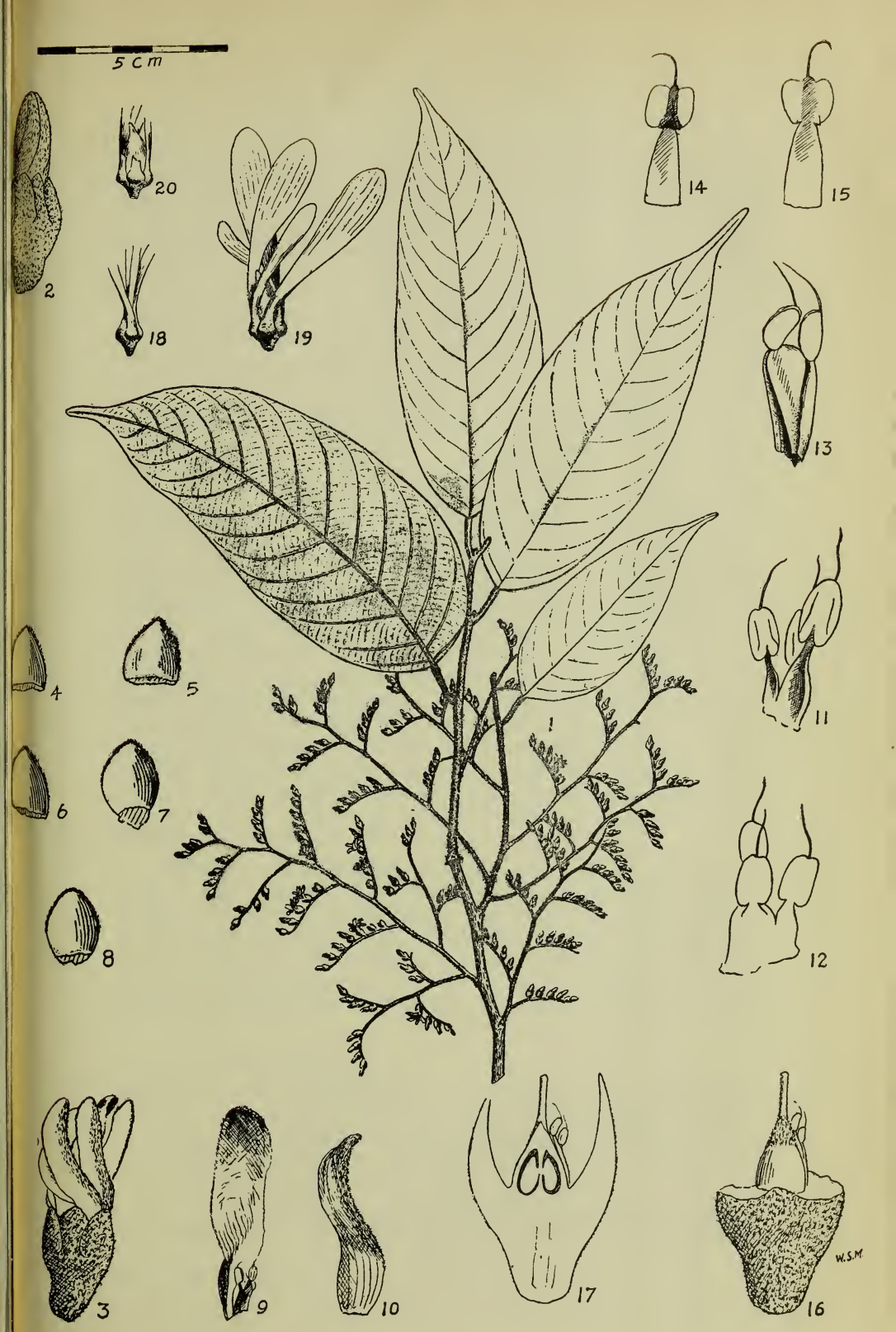

Plate 23. *Shorea acuminatissima* Sym.

similarly coloured but scabrid stellate-hairy on the nerves beneath; midrib slightly depressed above, prominent and stellate-hairy beneath; main nerves about 13 to 18 pairs, inconspicuous above, strongly elevate and stellate-hairy beneath; nervules faint but visible on both surfaces, usually sparsely hairy beneath; petioles terete, 1.0 to 1.5 cm. long, ferruginous-tomentose when young, scabrous and black later; stipules broadly oblong, oblique, rounded, about 1.0 × 0.5 cm., stellate-hairy, caducous. *Panicles* axillary and terminal, usually solitary, racemose, shorter than the leaves, pale tomentose; branchlets about 0.6 cm. apart, 1.0 to 2.0 cm. long when mature, each bearing 4 to 6 secund flowers (in the immature panicle the flower buds are sub-distichous and subtended by small, frequently bifurcate, puberulous bracteoles). *Flowers* about 2.0 mm. apart, ovate-lanceolate in mature bud, about 7.0 mm. long including the pedicel; pedicel 1.0 mm. long, densely pale tomentose. *Sepals* sub-equal, ovate-rotundate, obtuse, tomentose on the portions exposed in bud, white (C.F. 38722 & 38723). *Stamens* 15, pairs alternating with single stamens, of three sizes; anthers ovate-oblong, 2-celled; filaments about as long as the anthers, broad at the base, narrowing slightly towards the top; appendage to connective filiform, about as long as the anther. *Ovary* and stylopodium conical, the former glabrous, the latter densely hairy; style about as long as the stylopodium, cylindrical, glabrous; stigma capitate, small. *Fruit* sessile; calyx lobes chartaceous, sparsely hairy, three outer larger than the inner two; large wings spathulate, about 5.0 × 1.2 cm.; small wings similar but slightly (or considerably) smaller; bases of fruiting sepals thickened and woody, closely appressed to the base of the nut to form a 5-angled stellate-hairy cup, pointed at the base; mature nut ovate-oblong, rostrate, about 1.5 × 0.7 cm., densely fulvous-tomentose.

This is a typical member of the *Richetia* group of *Shorea* and appears more closely related to *S. Faguetiana* Heim than to any others with which I am familiar. The leaves are rather distinctive, and there should be little difficulty in identifying the species from vegetative characters alone. There is a distinct resemblance in leaf to *Shorea Forbesii* Brandis from New Guinea, but the natural relationship to it is remote. I suspect that *S. Forbesii* is a *Hopea*.

Collections examined :—

BRITISH NORTH BORNEO : C.F. 38723 (S.H. 4347) (Type of *S. acuminatissima* Sym.); Ayan; Experimental Station, 8th mile Sandakan, level land in forest; 29th March, 1935; flower. Field notes—"vern. name, *gagil;* tree 120 feet high, 53 in. girth; flower small, white, in cluster".

C.F. 41075 (S.H. 4886) (Paratype of fruit of *S. acuminatissima* Sym.); Puasa; Kabuli Forest Reserve, Sandakan, top

of hill; 21st April, 1935; fruit. Field notes—"vern. name *selangan kuning;* tree 90 feet high, 60 in. girth; fruit red".

C.F. 38722 (S.H. 4346), 38724 (S.H. 4348), 38792 (S.H. 4416).

BRUNEI: C.F. 30404.

The species here described as *Shorea acuminatissima* is a large tree which has been collected several times from British North Borneo under the names "*gagil*" and "*selangan kacha*". It has also been collected in Brunei. Timber samples have not been available for study but, from botanical considerations, it may safely be said that the timber will be classified as "white meranti sub-group 2" (*vide* Desch, *Mal. For. Rec.* 12: 37).

Shorea xanthophylla Symington, **sp. nov. Plate 24.**

S. multiflorœ (Burck) Sym. valde affinis sed foliis fructuque majoribus, petalis pro rata brevioribus, appendicibus ciliatis, differt.

Branchlets grey- or reddish-brown, pale puberulous towards the ends. *Leaves* oblong, acuminate at the apex, rounded or sub-cordate at the base, from about 19.0 × 6.0 cm. to 37.0 × 10.0 cm., glabrous on both surfaces, drying yellow-brown or greenish-yellow on the lower surface, usually of a greener tinge above; midrib very slightly elevate above, prominent beneath; main nerves 9 to 13 pairs, faint above, prominent beneath; nervules joining the main nerves in rather distant sub-parallel lines, invisible or faint above, rather prominent beneath; petioles 1.0 to 2.0 cm. long, rather thick, dark, rugose; stipules not seen. *Panicles* axillary or terminal, solitary or several together, lax, up to about 14.0 cm. long, pale tomentose; branches solitary or in pairs, irregularly branched; ultimate branchlets with 1 to 6 sub-secund flowers 1.3 mm. apart. *Flowers* ovate-lanceolate in nature bud, about 5.0 mm. long (including the pedicel); pedicel 1.0 mm. long, pale tomentose. *Sepals* sub-equal, ovate-rotundate, mucronate rounded or emarginate at the apex, tomentose outside, glabrous within. *Petals* oblong, tomentose on the portion exposed in bud, said to be white (38938), yellow (38742), lemon yellow (36776), and yellow ochre (38933). *Stamens* 15, pairs alternating with single stamens, of three heights; anthers elliptic-oblong, 2-celled; filaments 1 to 2 times as long as the anthers, broad at the base, narrow in the upper half; appendage to connective a curved awn about as long as the anther, minutely ciliate towards the end. *Ovary* ovate-conical, glabrous below, tomentose in the upper portion; style cylindrical, about ⅓ as long as the ovary, glabrous; stigma minute, apparently simple. *Fruit* sub-sessile; calyx lobes sub-equal, broadly ovate, about 1.0 cm. × 0.7 cm., decidous fulvous-tomentose, shortly united at their bases to form a woody receptacle; nut obovate, pointed, about 2.3 cm. × 1.7 cm., striate,

Plate 24. *Shorea xanthophylla* Sym.

Plate 25. *Shorea sandakanensis* Sym.

fulvous tomentose, on germination splitting along three lines at the apex.

This is yet another species of the *Richetia* group (*vide* p. 330). It is extremely close to *Shorea multiflora* (Burck) Sym. but differs markedly in the size of leaf and fruit.

Collections examined :—

BRITISH NORTH BORNEO : C.F. 36776 (S.H. 3998) (Type of *S. xanthophylla* Sym.); Puasa; Bettotan, Sandakan, top of hill; 23rd Sept. 1934; flower. Field notes—"Vern. name, *Karai batu;* tree 70 feet high, 18 in. girth; flower lemon yellow."

C.F. 38742 (S.H. 4366), 38933 (S.H. 4557), 38938 (S.H. 4562), 41108 (S.H. 5496).

SARAWAK : For. Dept. Sar. 00277 (Paratype of fruit of *S. xanthophylla* Sym.); Bogil; Sungei Babong, Beseri, hill; 6th August, 1935; mature fruit. Field notes—"tree 40 feet high, 21 in. girth".

Shorea xanthophylla is a "new" species which has been recorded several times in the neighbourhood of Sandakan in British North Borneo and once in Sarawak. Our only information concerning the tree is that given on the herbarium labels of native collectors. It appears to be a small to medium-sized tree of low hills for which the following vernacular names have been recorded in B.N.B.—*selangan babi, selangan kuning,* and *karai batu. Pisang-pisang* has also been recorded on two occasions, possibly on account of a supposed leaf resemblance to some species of *Anonaceæ*. Timber specimens have never been collected but, from botanical considerations, there can be little doubt that the timber should be classified as "white meranti sub-group 2" (*vide* Desch, *Mal. For. Rec.* 12 : 37). The specific epithet, *xanthophylla,* refers to the characteristic yellowish colour of the dried leaves.

Shorea sandakanensis Symington, **sp. nov. Plate 25.**

S. macropterœ Dyer affinis, sed foliis majoribus minus coriaceis, paniculis longioribus laxioribus, floribus majoribus, alis fructus longioribus, nuce subgloboso dense tomentoso differt.

Branchlets terete, tawny-tomentose when young, later becoming dark. *Leaves* oblong, acuminate at the apex (acumen about 1.5 cm. long), truncate or rounded at the base, usually about 18.0 × 6.5 cm. but varying from about 9.0 × 4.0 cm. to 23.0 × 9.5 cm., glabrous above, sparsely stellate-hairy on the nerves beneath, usually drying yellow-brown on both surfaces; midrib slightly depressed above, prominent striate and sparsely hairy beneath; main nerves 13 to 15 pairs, inconspicuous above, prominent beneath; nervules in fine curved parallel lines, distinctly visible but not very prominent on either surface;

petioles 1.0 to 2.0 cm. long, rugulose, tawny-tomentose to black; stipules oblong, less than 1.0 cm. long, caducous. *Panicles* axillary and terminal, solitary, when axillary shorter than the leaves; main branches rufescent-tomentose, pale tomentose towards the ends; ultimate branchlets regularly alternating about 1.5 cm. apart, usually simple but occasionally bifurcated, 1.0 to 3.0 cm. long, bearing 3 to 7 (usually 5) distichous flowers. *Flowers* "red, no odour" (38730), "olive green" (38839), "lake green" (38778), about 5.0 cm. apart, sessile, about 1.0 cm. long in mature bud. *Sepals* sub-equal, ovate-rotundate, acute, pale to silvery tomentose outside, glabrous within. *Petals* linear-oblong to linear, tawny-villous on the portions exposed in bud. *Stamens* 15, of three sizes; filaments flattened, broad at the base, gradually narrowing upwards; anthers globular, cells sub-equal; appendage to connective a curved awn about as long as the anther (slightly shorter in large stamens), at first erect, later deflexed. *Ovary* and stylopodium cylindric-conical, glabrous in the lower portion, villous above; style terete, glabrous, about half the length of the ovary and stylopodium; stigma very slightly enlarged, obscurely 3-lobed. *Fruit* a 5-winged nut; sessile; bases of accrescent calyx lobes thickened, woody, embracing the lower portion of the nut only, minutely stellate-hairy; three outer wings sub-equal, linear, rounded at the apex, auriculate at the base, about 11.0 × 1.5 cm. to 14.0 × 2.0 cm., 9 to 11-nerved, sparsely minutely hairy, red when young (C.F. 41051); two inner wings much shorter, linear, irregular at apex, about 3.0 × 0.5 cm. to 6.0 × 0.7 cm., about 5-nerved; nut ovate-globular, rostrate, about 1.8 × 1.2 cm., densely pale tawny-tomentose; rostellum about 3.0 mm. long, pale tawny-tomentose.

There are several Bornean forms, some as yet undescribed, closely related to *Shorea macroptera* Dyer from the Malay Peninsula. So close, indeed, are they that some authors would probably interpret them as variations of a polymorphous species. One of these forms (*S. Bailloni* Heim) was actually united with the Peninsula species by Brandis (*Journ. Linn. Soc.* 31 : 90 (1895)). As herbarium material of these forms accumulates, however, it becomes increasingly evident that the differences are such as to justify the recognition of several distinct species. The differences between *S. sandakanensis* and *S. macroptera* Dyer are of degree rather than kind, nevertheless, the sum of these differences is so constant that I feel confident in separating them specifically.

Collections examined : —

BRITISH NORTH BORNEO : C.F. 38730 (S.H. 4354) (Type of *S. sandakanensis* Sym.); Agama; Kabuli Forest Reserve, Sandakan, level ground; 16th March, 1935; flower. Field

Plate 26. *Shorea Smithiana* Sym.

Notes—"vern. name, *seraya;* tree, 100 ft. high, 60 in. girth; flower red, no odour; this form of seraya has usually short bole".

C.F. 38760 (S.H. 4384), C.F. 38765 (S.H. 4389), C.F. 38778 (S.H. 4402), C.F. 38839 (S.H. 4463), C.F. 38893 (S.H. 4517), C.F. 38946 (S.H. 4570), C.F. 41051 (S.H. 4676), C.F. 41068 (S.H. 4850: Paratype of fruit of *S. sandakanensis* Sym.); Agama; Kabuli—Sepilok Forest Reserve, Sandakan, level ground; 5th June, 1935; fruit. Field Notes—"vern. name, *seraya;* tree 40 ft. high, 32 in. girth; fruit greenish-red".

? Creagh, s.n., July 1896.*

Shorea sandakanensis appears to be common in the vicinity of Sandakan, on flat land or on low hills. The majority of the collections have been named *seraya,* but one is named *seraya puteh,* and one *selangan bangar.* It appears to grow to great size, one tree of 200 ft. in height and 108 in. girth being recorded.

Shorea Smithiana Symington, **sp. nov.** "*Shorea* sp. No. 21606," van Slooten ex Merr. Plant. Elmer. Born. 205 (1929). **Plate 26.**

S. rugosæ Heim foliorum ramulorumque habitu similis, sed staminibus 22–26, antheris late oblongis, connectivorum appendicibus filiformibus, stylopodio oblongo basi constricto distincta.

Branchlets rather coarse, dark, glabresent to fulvous scabrous stellate-tomentose at the ends. *Leaves* broadly obovate to elliptic-oblong, acute or shortly blunt acuminate at the apex, truncate to cordate at the base, about 10.0 × 6.0 cm. to 17.0 × 8.5 cm., sparsely stellate-hairy and drying dull grey-brown above fulvous-tomentose on the lower surface; midrib depressed and stellate-tomentose above, elevate, thick, closely tomentose, and furnished with coarse scabrous hairs beneath; main nerves 15 to 20 pairs, inconspicuous above, elevate, tomentose, and scabrous hairy beneath; nervules faint and sparcely hairy above, in conspicuous parallel lines, tomentose and scabrous hairy beneath; petioles 2.0 to 3.0 cm. long, rugulous, fulvous scabrid-tomentose; stipules about 1.0 cm. long, oblong, subfalcate, scabrid-tomentose, caducous. *Panicles* terminal and axillary, in solitary racemes usually larger than the leaves (up to 23.0 cm. long), fulvous-tomentose becoming paler at the branchlets; branchlets regularly alternating, about 1.0 cm. apart, up to 3.5 cm. long, decreasing in length towards the end of the raceme, 3- to 8-flowered; branchlets and flowers furnished with sub-ovate, obtuse, pale

* I examined this specimen (in young fruit) at Kew and was of opinion that it is this species, although the leaves have dried a rather unusual purple-grey colour.

tomentose bracts and bracteoles about 7.0 mm. long. *Flowers* secund, about 2.0 to 3.0 mm. apart, ovate-lanceolate in bud, about 1.0 cm. long including the pedicel; pedicel 1.0 mm. long, tomentose. *Sepals* sub-equal ovate-acute, the two inner slightly thinner and sub-acuminate, tomentose outside. *Petals* linear-oblong, blunt, silvery tawny-tomentose on the portions exposed in bud, pink (Smith), red (Kamis, 41071). *Stamens* 22 to 26, of three heights; filaments broad and flattened at the base, narrowing abruptly to the filamentous upper portion; anthers broadly oblong, much shorter than the filaments, 4-celled, cells sub-equal; appendage to connective filiform, about as long as the filament. *Ovary* and stylopodium shaped like an hour-glass, tomentose; style short, cylindrical, glabrous; stigma minute. *Fruit* a 5-winged nut; stalk very short, about 2.0 mm. long, sparsely stellate-hairy; bases of accrescent calyx lobes thickened and woody, closely embracing the lower half of the nut, sparcely stellate-hairy; three outer wings linear, obtuse at the apex, up to about 15.0 × 2.0 cm., sparsely minutely hairy, 7- to 10-nerved with arched or sub-reticulate nervules; two inner wings similar but about ¾ as long as the outer wings and with fewer nerves; nut ovate-conical, rostellate, about 2.0 × 1.4 cm., pale silky tawny-tomentose; rostellum about 5.0 mm. long, sharp and slightly curved.

This species resembles *S. rugosa* Heim in vegetative characters but it is quite distinct in details of floral morphology. I can suggest no closely-related species. The stamens, ovary, and stylopodium, are of the type seen in the *Pierrea* group of *Hopea* but rare in *Shorea*. The same combination may be seen in *S. compressa* Burck and *S. mecistopteryx* Ridl., but *S. Smithiana* differs from these in the more numerous stamens and, taking into consideration the sum total of their characters, I do not feel that the relationship is very close.

Collections examined : —

BRUNEI : C.F. 30472 (Type of *S. Smithiana* Sym.); J.S. Smith; Labi Hills, hillside 700 ft.; 25th Nov. 1934; flower. Field notes—"Tree 150 feet high, 12 feet girth; flower pink; bark brown with very deep fissures; large buttresses".

C.F. 30524 (Paratype of fruit of *S. Smithiana* Sym.); J.S. Smith; 23rd Feb. 1935; fruit from same tree as C.F. 30472.

C.F. 30538 and 39646.

BRITISH NORTH BORNEO : C.F. 36727, 39018 (S.H. 4642), 41070 (S.H. 4858), 41071 (S.H. 4860), 41080 (S.H. 4932); Elmer No. 21606 (Sun Yatsen No. 56097).

This new *Shorea* was first collected in British North Borneo by A. D. E. Elmer about 1922, but it was not until 1934–35 that

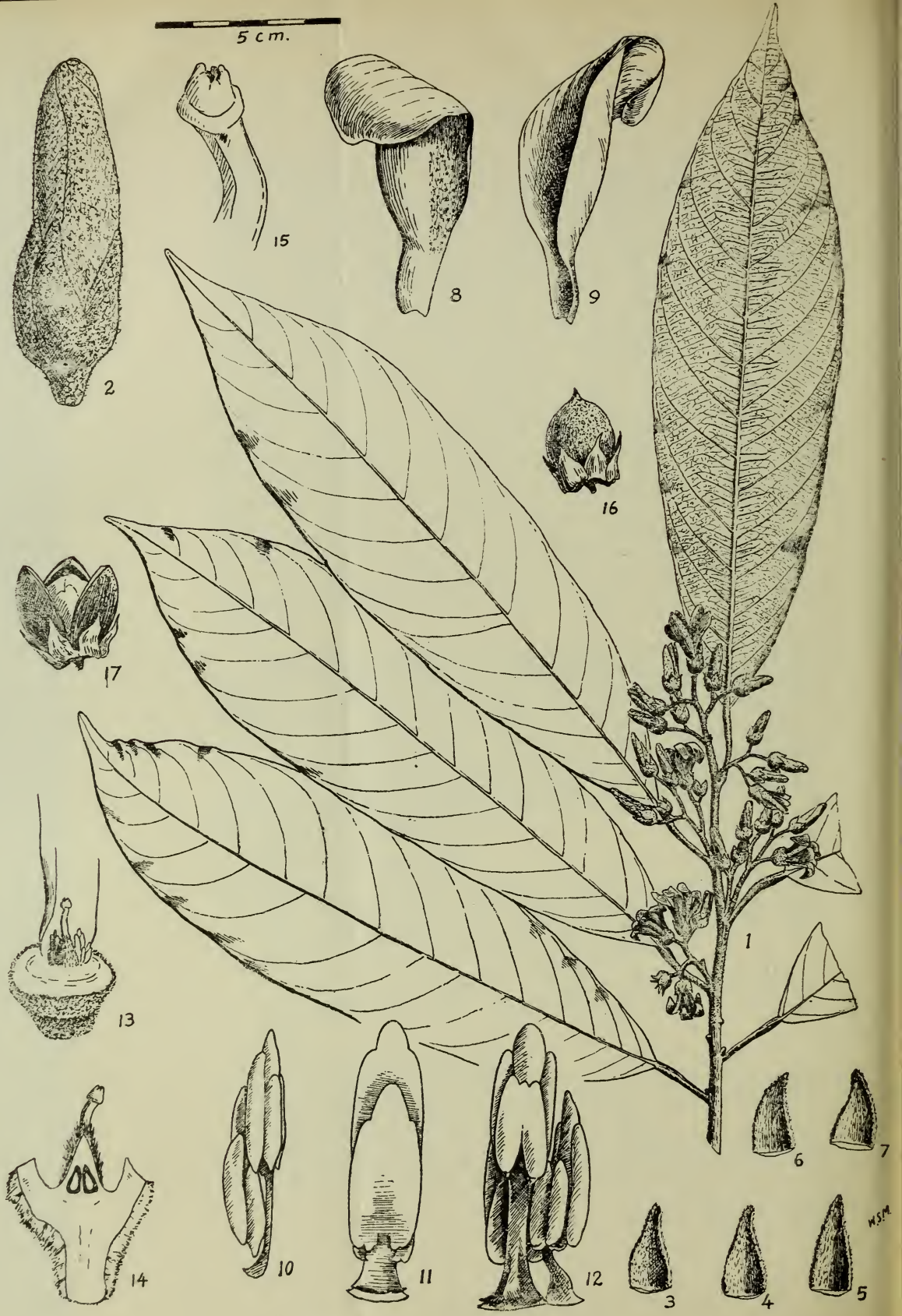

Plate 27. *Vatica diospyroides* Sym.

adequate material was available for purposes of description. During 1934–35 the species was collected in flower or fruit several times in both British North Borneo and Brunei. From the former territory the names *urat mata, seraya,* and *seraya merah,* are recorded, and from the latter *berat* (Murut) and *mengkabang rambai* (Dyak). It is evidently a good-sized tree, specimens over 12 feet girth having been recorded; it produces a timber apparently of the "light red meranti" grade.

I have named the tree after Mr. J. S. Smith, State Forest Officer, Brunei, from 1933–1936, whose interest in the collection of botanical material has resulted in invaluable contributions to our knowledge of Bornean trees.

Vatica diospyroides Symington, **sp. nov.** *Vatica Scortechinii* (King) sensu Brandis in Journ. Linn. Soc. 31 : 122 (1895), sensu Craib, Flor. Siam Enum. 1 : 141 (1925), et sensu V. Sl. in Bull. Jard. Bot. Buitenz. III, 9 : 108 (1927), quoad Curtis 2934; non *Retinodendron Scortechinii* King. **Plate 27.**

A *V. Scortechinii* (King) Brandis foliis tenuioribus, stipulis caducis, fructu majore, calycis lobis acuminatis recedit.

Branchlets pale, fuscous stellate-tomentose towards the ends. *Leaves* oblong or linear-oblong, acuminate at the apex, acute at the base, from about 12.0 × 2.7 cm. to 27.0 × 8.25 cm., glabrous and drying a pale yellow-green on both surfaces; midrib elevate on both surfaces, particularly the lower, pale yellow; main nerves about 15 to 21 pairs, prominent beneath, slightly less prominent above, usually with 2 to 4 short intermediary nerves; nervules reticulate, prominent on the lower surface; petioles 1.0 to 2.5 cm. long, rather thick, rugulose above, fuscous-tomentose when young; stipules not seen. *Panicles* axillary and terminal, solitary or 2 to 3 together, racemose, 2.0 to 4.0 cm. long, fulvous flocculent stellate-tomentose, about 3- to 12- flowered. *Flowers* lanceolate-oblong in bud, about 1.5 cm. long (including the pedicel); pedicel 2.0 mm. long or almost absent, fulvous flocculent stellate-tomentose. *Sepals* all similar, slightly imbricate or pseudo-valvate, deltoid-acuminate or ovate-acute, tomentose on both surfaces. *Petals* slightly contorted in bud, oblong-obtuse, densely fulvous-tomentose on the portions exposed in bud, "creamy white, very fragrant" (Kerr). *Stamens* 15 (rarely 13 or 14), of three heights, episepalous pairs alternating with solitary intermediate stamens; filaments short, flattened, broad at the base; anthers much larger than the filaments except in the tallest row of stamens, posterior cells much shorter than the anterior; appendage to connective short, thick, claviform. *Ovary* small, conical, ferruginous-pilose; style about as long as, to twice as long as, the ovary, ridged, glabrous; stigma sub-conical, ringed at the base, obscurely 3- to 6-lobed. *Fruit* : stalk short, 2.0 mm. long,

fuscous-tomentose; sepals united at the base to form a thin concave disc, lobes ovate, caudate-acuminate, margins sinuate, about 1.5 × 0.75 cm., sub-verrucose with a sparse pale tomentum; nut ovate-globose, rostellate, about 2.5 × 2.0 cm., fulvous farinaceous-tomentose; rostellum slightly curved, about 3.0 mm. long; pericarp thick, woody, splitting into three equal portions.

This is a very distinct species of *Vatica* which differs from most species in the subgenus *Isauxis* in lacking recurved fruiting sepals. The fruits in this respect more closely resemble those of *V. Scortechinii* (King) Brandis and *V. sarawakensis* Heim than any others, but the flocculent inflorescence is more suggestive of the subgenus *Synaptea*. The earliest collection was made by Curtis in Pang-nga in 1893, but this was referred by Brandis to *Vatica Scortechinii* (King). The latter, however, is quite distinct in the broader and thicker leaves, the large persistent stipules, and the smaller grooved fruits with obtuse calyx-lobes.

Collections examined :—

SIAM: Kerr 10011 (Paratype of flower of *V. diospyroides* Sym.); A. F. G. Kerr; Bangkok, altitude 5 m.; 27th Jan. 1925; flower. Field notes—"Local name, *chan ta paw;* shrub about 3 m. high; cultivated for its fragrant flowers."

Kerr 20546 (Type of *V. diospyroides* Sym.); leg. Heya Wruit Waradern (?); Bangkok; 19th July, 1931; mature fruit. Field notes—"Local name, *chan kapaw;* tree; cultivated for its fragrant flowers".

Kerr 17045 (Takuapa), 18286 (Surat), 18527 (Pang-nga); Curtis 2934 (Pang-nga); For. Dept. Siam 819.

This species is evidently a small tree which has been collected wild in evergreen forest in Peninsular Siam. The type specimens, however, came from Bangkok where the tree is said to be cultivated for its fragrant flowers. The name *Vatica diospyroides* is given because the fruits bear a distinct resemblance to those of certain species of *Diospyros*.

Oxford-Borneo Expedition 1932—Additional Dipterocarpaceæ

Shorea mecistopteryx Ridl. in Kew Bull. 1925: 280; V.Sl. ex Merr. in Univ. Calif. Pub. Bot. 15 : 203 (1929).

Native Collector No. 2269; Dulit, under 300 m., primary forest; Oct. 18th, 1932; flower. Field note—"*Urat Mata,* tree, 39 m. high. Large buttresses. Bark 0.8 – 1.0 cm. thick, reddish in blaze, surface yellowish grey, smooth, flaking off in large thin irregular pieces. Not the same species as the tree of same name at Marudi. Timber Class I (c)."

Shorea mecistopteryx has been known hitherto only from two fruiting collections (Taha *s.n.* (the type) and Elmer 21569) from

localities near Sandakan in British North Borneo. The leaf shape and distinctive soft indumentum are so characteristic that I feel justified in referring the Dulit collection to this species. Flowering material from the type locality is, however, desirable to put the matter beyond doubt. The following is a description of the flowers of the Sarawak plant—

Panicles axillary, stellate-tomentose, ferruginous on the main stem, grey on the branchlets, racemose, up to 12.0 cm. long; branchlets simple or branched, about 1.0 to 4.0 cm. long, each bearing 2 to 6 flowers subtended by sub-persistent bracteoles; bracteoles oblong, obtuse, sparsely sericeous-tomentose outside, glabrescent within. *Flowers* elongate-pointed in bud, up to 1.8 cm. long including the pedicel; pedicel 2.0 mm. long, pale tomentose. *Sepals* tomentose outside, minutely so on the upper half inside; three outer oblong, rounded at the apex; two inner slightly shorter, acute at the apex. *Petals* linear-oblong, rounded at the apex, pale tomentose outside on the portion exposed in bud. *Stamens* 15, of two different heights, pairs alternating with single stamens; filaments broad at the base, thickened above, then narrowing abruptly to a short filamentous portion, three to four times as long as the anthers; anthers rotund-ovate, cells sub-equal in size; appendage to connective filiform, about 1 to 3 times as long as the stamen. *Ovary* with stylopodium shaped like an hour glass (as in *Pierrea* group of *Hopea*), glabrous; style short; stigma obscurely 3-notched.

On floral characters this species appears to be related to *S. pinanga* Scheff. and *S. compressa* Burck, species characterized by a similar ovary and long, filiform connectival appendages.

Van Slooten (*op. cit.* p. 202) has questioned whether *S. chrysophylla* Ridl. (*Kew Bull.* 1926 : 470) differs from *S. mecistopteryx* Ridl. The collection described above lends support to Ridley's view. Although the ovary and stylopodium in *S. mecistopteryx* are exactly similar to those of *S. chrysophylla*, the indumentum of the leaves is quite distinct.

Cotylelobium malayanum V.Sl. in Bull. Jard. Bot. Buitenz. III, 12, pt. 1 : 43 (1932). *Cotylelobium flavum* sensu V. Sl. in op. cit. 10 : 396, fig. 1 (1930), non Pierre, Fl. For. Cochinch., tab. 258A (1891).

P. W. Richards No. 1816; Ulu Koyan, Mt. Dulit, c. 900 m., white sand forest; 15th Sept. 1932; flower. Field note—"*Resak peniau* or *resak durian*. Tree c. 25–30 m. high, 33 cm. diam. Flowers creamy white with strong, sweet, vanilla-like scent. Anthers bright yellow. Leaves hard and leathery, dark green above, light brown below. No buttresses. Bark stripping in thick longitudinal flakes".

Distribution.—Malay Peninsula, Sumatra, and Borneo.

Explanation of Plates

Plate 17. **Hopea Pierrei** Hance. 1, flowering twig. 2, sterile twig showing domatia on leaves. 3, flower bud (immature). 4,=3 with sepals removed. 5 & 6, outer sepals. 7, 8, & 9 inner sepals. 10 & 11, petal from flower bud. 12 & 13, stamens. 14, ovary & stylopodium. 15, section through 14. 16, ripe fruits. (Drawings of 1 & flower parts based on Pierre 1425; 2 on Foxw. 8; 16 on Guibier 2). *Scale applies to* 1, 2, & 16 *only*.

Plate 18. **Hopea Beccariana** Burck. 1, flowering twig. 2, branchlet of panicle with expanding flower & two buds. 3 & 4, outer sepals. 5, 6, & 7, inner sepals. 8 & 9, petal from mature flower. 10, 11, 12, & 13, stamens from mature flower. 14, flower with perianth parts removed to show ovary. 15, section through ovary. 16 & 17, immature fruits. 18 & 19, mature fruits. (Drawings of 1 & flower parts based on C.F. 9661 & 11673; 16 & 17, on C.F. 16574; 18 & 19 on S'p. 3474). *Scale applies to* 1, 16, 17, 18, & 19 *only*.

Plate 19. **Hopea pedicellata** (Brandis) Sym. 1, flowering twig. 2, branchlet of panicle with expanding flower & two buds. 3 & 4, outer sepals. 5, 6, & 7, inner sepals. 8 & 9, petal from mature flower. 10, 11, 12, & 13, stamens. 14, flower with perianth parts removed to show ovary. 15, section through ovary. 16, panicles with immature fruits. 17 & 18, mature fruits. (Drawings of 1 & flower parts based mainly on Curtis 167; 16 on C.F. 26913; 17 & 18 on S'p. 3474). *Scale applies to* 1, 16, 17, & 18 *only*.

Plate 20. **Shorea assamica** Dyer forma **globifera** (Ridl.) Sym. 1, flowering twig. 2, immature twig from sapling showing stipules. 3, branchlet of young inflorescence showing bracts. 4, flower bud. 5–9, sepals. 10 & 11, petal from mature bud. 12 & 13, stamens. 14, ovary. 15, 16, & 17, stigmas. 18, stigma partially disected. 19 & 20, fruits. (Drawings of 1 & flower parts based on C.F. 3072; 2 on C.F. 27226; 3 on C.F. 10369; 19 & 20 on 39071). *Scale applies to* 1, 2, 3, 19, & 20 *only*.

Plate 21. **Parashorea malaanonan** (Blanco) Merr. 1, flowering twig. 2, flower bud. 3, 4, & 5, outer sepals. 6 & 7, inner sepals. 8 & 9, petal from mature flower. 10, flower—sepals & petals removed. 11 & 12, stamens. 13, ovary. 14, end of the style showing stigma. 15, section through ovary. 16, immature fruit. 17 & 18, mature fruit. (Drawings of 1 & flower parts based on C.F. 39019; 16 on C.F. 30531; 17 & 18 on Elmer 21739). *Scale applies to* 1, 16, 17, & 18 *only*.

Plate 22. **Parashorea malaanonan** (Blanco) Merr. var. **tomentella** Sym. 1, flowering twig. 2, flower bud. 3, 4, & 5, outer sepals. 6 & 7, inner sepals. 8 & 9, petal from expanded flower. 10, flower—sepals & petal removed. 11 & 12, stamens. 13, flower—sepals, petals, & most stamens removed. 14, end of style & stigma. 15, section through ovary. 16 & 17, young fruits. 18=17 with sepals removed. (Drawings of 1 & flower parts based on C.F. 38745; 17 on C.F. 38845; 16 on C.F. 41064). *Scale applies to* 1, 16, 17, & 18 *only*.

Plate 23. **Shorea acuminatissima** Sym. 1, flowering twig. 2, flowering bud. 3, expanding flower. 4 to 8, sepals. 9 & 10, petal from mature flower. 11 & 12, stamens from flower bud. 13, 14, & 15,

mature stamens. 16, flower—perianth removed. 17, section through ovary. 18, immature fruit. 19 & 20, mature fruit. (Drawings of 1 & flower parts on C.F. 38723; fruit on C.F. 41075). *Scale applies to* 1, 18, 19, & 20 *only*.

Plate 24. **Shorea xanthophylla** Sym. 1, flowering twig. 2, mature inflorescence. 3, mature flower bud. 4, 3 with sepals & petals removed. 5 to 9, sepals. 10 & 11, petal from mature bud. 12 & 13, stamens. 14, section through ovary. 15, stigma. 16, fruit. 17, germinating fruit. (Drawings of 1 & flower parts based on C.F. 36776; 2 on C.F. 38742; fruits on For. Dept. Sarawak 277). *Scale applies to* 1, 2, 16, & 17 *only*.

Plate 25. **Shorea sandakanensis** Sym. 1, flowering twig. 2, flower bud. 3 to 7, sepals. 8 & 9, petals from bud. 10 & 11, petal from expanded flower. 12, ovary—sepals & petals removed. 13, 14, & 15, mature stamens. 16, section through ovary. 17, stigma. 15 & 19, mature fruit. (Drawings of 1 & flower parts based on C.F. 38730 & 38778; fruits on C.F. 41068). *Scale applies to* 1, 18, & 19 *only*.

Plate 26. **Shorea Smithiana** Sym. 1, flowering twig. 2, young inflorescence with bracts. 3, flower bud. 4, expanding flower. 5 to 9, sepals. 10 & 11, petal from mature flower bud. 12 & 13, stamens. 14, ovary—sepals & petals removed. 15, section through ovary. 16 & 17, fruits. (Drawings of flower parts based on C.F. 30472; fruits on C.F. 30524). *Scale applies to* 1, 2, 16, & 17 *only*.

Plate 27. **Vatica diospyroides** Sym. 1, flowering twig. 2, mature flower bud. 3 to 7, sepals. 8 & 9, petal from mature flower. 10, 11 & 12, stamens. 13, ovary—sepals & petals removed. 14, section through ovary. 15, stigma. 16 & 17, fruits. (Drawings of 1 based on Kerr 10011 & 18577; flower parts on Kerr 10011; fruits on Kerr 20546). *Scale applies to* 1, 16, & 17 *only*.

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A REDEFINITION OF THE GENUS TERATOPHYLLUM

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When Kuhn published the original diagnosis of the genus Teratophyllum in 1869 he included in it the bipinnate species previously known as *Polybotrya articulata* J. Sm. and *Polybotrya Wilkesiana* Brack. These differ notably in several characters from the other species of the genus; so much so that when I prepared an account of Teratophyllum in 1932 (this Bulletin, vol. 5, pp. 277–304) I excluded them as possibly referable to a distinct genus. Copeland has included them in Lomagramma, but all known species of Lomagramma have characteristic features of spores and venation which are quite different from those of the two species in question (this Bulletin, Vol. 9, p. 194). I have now examined a number of specimens, and have come to the conclusion that the best treatment is to unite them to Teratophyllum as proposed by Kuhn. His diagnosis however omits a number of important points, and I have prepared a new one which includes what seem to me the essential features of the genus. The genus as so defined consists of two sections. The first and larger section comprises those species dealt with in my former paper; the second section has hitherto not received adequate description, and I give below as full an account of its species as the material at present available allows.

I am grateful to the authorities in charge of various herbaria for the loan of specimens, or for permission to examine specimens. The herbaria in question are cited as follows: Brisbane (Br.) British Museum (B.M.), Buitenzorg (B.), Kew (K.), Philippine National Herbarium (M.), Singapore (S.), U.S. National Herbarium (W.).

TERATOPHYLLUM Mett., emend. Holttum

Rhizoma paleis peltatis adpressis fugacibus squamosum, alte scandens, dorsiventrale, frondium duos vel plures ordines ferens. *Frondes* prope solum (bathyphylla) minores, multiformes; frondes superiores (acrophylla) majores, pinnatæ vel bipinnatæ. *Pinnæ* acrophyllorum omnes articulatæ pinnulæ articulatæ apicales exceptæ; venulæ pinnarum vel pinnularum sterilium liberæ, simplices vel furcatæ, ante marginem terminatæ, margines integræ vel serratæ, *pinnæ vel pinnulæ fertiles* plus minusve angustatæ, sæpe lineares, semper acrostichoideæ, nervatio earum plerumque venulis irregularibus supernumerariis sæpe anastomosantibus prope paginam inferiore aucta; *paraphyses* nullæ; *sporæ* perisporio vestitæ.

1. *Euteratophyllum.* Rhizoma tenue, frondes semper biseriatæ, acrophylla semper pinnata. Species typica: *Lomaria aculeata* Bl.

2. *Polyseriatæ*. Rhizoma adultum crassius, frondes polyseriatæ, acrophylla sterilia et fertilia sæpe bipinnata. Species typica: *Polybotrya articulata* J. Sm.

The section Euteratophyllum is confined, so far as at present known, to the Malaysian region, inclusive of the Philippines and New Guinea. The section Polyseriatæ does not occur west of Celebes, but extends into the Pacific as far as Tahiti, also northwards throughout the Philippines and southwards to Queensland.

Key to the section Polyseriatæ

Fertile pinnæ hardly more than 1 mm. broad *T. Brightiæ*

Fertile pinnæ much broader, or fertile fronds bipinnate
Sterile pinnules auricled on upper base *T. articulatum*
Sterile pinnules not auricled *T. Wilkesianum*

Teratophyllum articulatum (J. Sm.) Mett. Kuhn in Ann. Mus. Lugd. Bat. 4: 297. 1869.

Polybotrya articulata J. Sm. (nomen nudum) Journ. Bot. 3: 401. 1841.

Fée, Hist. Acrost. 74, t. 37. 1845.

Lomagramma articulata Copel. Phil. Journ. Sci. 3C: 32. 1908.

Lomagramma bipinnata Copel. Phil. Journ. Sci. 11C: 114. 1916.

The type of this species is Cuming 296, from Leyte. I have seen specimens of this collection at Kew and from the U.S. National Herbarium. I have also examined the specimens listed below. I have not examined the type of Copeland's *Lomagramma bipinnata*, but from description it seems to fall well within the range of variation of the present species. The range of variation is considerable, and of the same character in widely separated countries. The essential features of the species may be summarised as follows.

Rhizome to 1 cm. diameter, longitudinally ridged, at first covered with small peltate lanceolate almost black scales with brown more or less fimbriate edges, smaller scales entirely brown.

Stipes to at least 25 cm. long; main rachis not winged, but 2-grooved above, scaly when young.

Fronds to about 80 cm. long and 30 cm. wide, with about 15 pairs of pinnæ; basal and apical pinnæ somewhat smaller than the rest.

Pinnæ to 20 cm. long and 3.5 cm. wide, with stalks up to 1 cm. long; pinnules about 20 pairs; pinna-rachis winged, the wing interrupted at the base of each pinnule and expanded into a narrow lamina at the apex of the pinna.

Sterile pinnules on short winged stalks about 1 mm. long, variable in size and shape, commonly about 18 mm. long and 7 mm. wide in the middle; upper base truncate, usually 7–8 mm. wide, forming a prominent auricle, sometimes a distinct basal lobe; lower base narrowly cuneate; both edges (except the base) obliquely toothed, the teeth not more than 1 mm. deep, one to each vein-ending; apex rounded or bluntly pointed; veins mostly forked, except the vein in the basal auricle or lobe which is pinnate; surfaces of fully expanded frond naked except for a few scales on the lower surface, mostly on the midrib, the larger scales sac-shaped.

Fertile pinnules on winged stalks 2 mm. long, about 4–7 mm. long and 1 mm. wide when dry, the upper base distinctly auricled, the apex rounded.

Young stages. One specimen examined shows the young stage of the plant, namely Clemens 1018 from Mindanao. The rhizome is very slender and has simply pinnate fronds to about 12 cm. long and 2.5 cm. wide; the fronds each have about 10 pairs of pinnæ and an apex consisting of a narrow lamina continuous with the rachis. The stipes are not more than 1 cm. long, and in all cases there are one or two basal unpaired pinnæ on the side of the rachis towards the base of the plant, the side of the rachis towards the apex of the plant being devoid of pinnæ (this is in agreement with some species of Euteratophyllum). The pinnæ are up to 12 mm. long and 7 mm. wide, the general shape like the pinnules of the acrophylls but the veins fewer and the teeth larger and rounded. The lower surfaces bear sac-shaped scales like those of the acrophylls.

This specimen evidently represents a young stage, and we have no definite information as to whether the fronds on it are normal bathyphylls, or whether such may be bipinnate on larger rhizomes. The resemblance to *T. aculeatum* is striking, but the shape of the pinnæ and the scales are characteristic of *T. articulatum*, and there can be no doubt that reference to the present species is correct.

A specimen from Celebes (part of Bünnemeijer 11138) may perhaps represent more normal bathyphylls. The fronds are small, bearing pinnules of hardly more than half the usual size, and are attached to a slender rhizome. In the same collection are fronds of normal size with larger pinnules.

Distribution: from Celebes and the Philippines through New Guinea to the Solomon Islands.

PHILIPPINES. *Leyte:* Cuming 296 (type collection, K., W.); Dagami, C. A. Wenzel 89 (M.). *Luzon:* Mt. Masingit, Lubuagan, Kalinga Subprov., Bur. Sci. 37500, Ramos and Edano (M., B.); Caraballo Mt., Nueva Vizcaya Prov., Bur. Sci. 13730, 13733, 13716, Loher (M.). *Mindanao:* Camp Keithley, Lake Lanao, M. S. Clemens 1073 (M.), 1018 (M.), s.n. (B.).

CELEBES. Lombasang, N. W. Celebes, Bünnemeijer 11138 (B.). Papepekang, Bonthain, Teysmann 13688 (B.). Mt. Bonthain, S. W. slope, 1500 m., Posthumus 2720 (S.). Prov. Minahassa, Koorders 17073 (B.), 17056 (B.), 17032 (B.).

CERAM. 1000–1400 m., Rutten 2213 (B.).

NEW GUINEA. Nassau Geb. 700 m., Docters van Leeuwen 10680 (B.). Boridi, Papua, 4,800 ft. Carr. 14212 (S.). K. Wilhelmsland, Wapao, 600 m., Bamler (Rosenstock, Fil. Novoguin. 122, M.).

SOLOMON ISLANDS. Bougainville, 1600 m., Kajewski 1711 (M.), 1200 m., Kajewski 2669 (M.).

Teratophyllum Brightiæ (F. von. Muell.) Holttum comb. nov. **Plate 28.**

Acrostichum Brightiæ F. von Mueller, Fragmenta 7 : 119. 1870.

The original description of this species is as follows : —

Alte scandens, frondibus simpliciter pinnatis, rachi aptera, *pinnis cum rachi articulatis, sterilibus fere conformibus membraneis perangusto-vel falcato-lanceolatis conspicue petiolulatis ad basim fere cuneatam inæquilateris* tenui-acuminatis irregulariter repando-crenulatis subtus pallide virentibus, venis tenuibus multis inferme longiuscule simplicibus superne dicladis, *apicibus venarum fere clavato-incrassatis ante marginem evanescentibus*, rachi frondis fertilis squamulis angustis acutis crispulis conspersa, pinnis anguste linearibus remotiusculis.

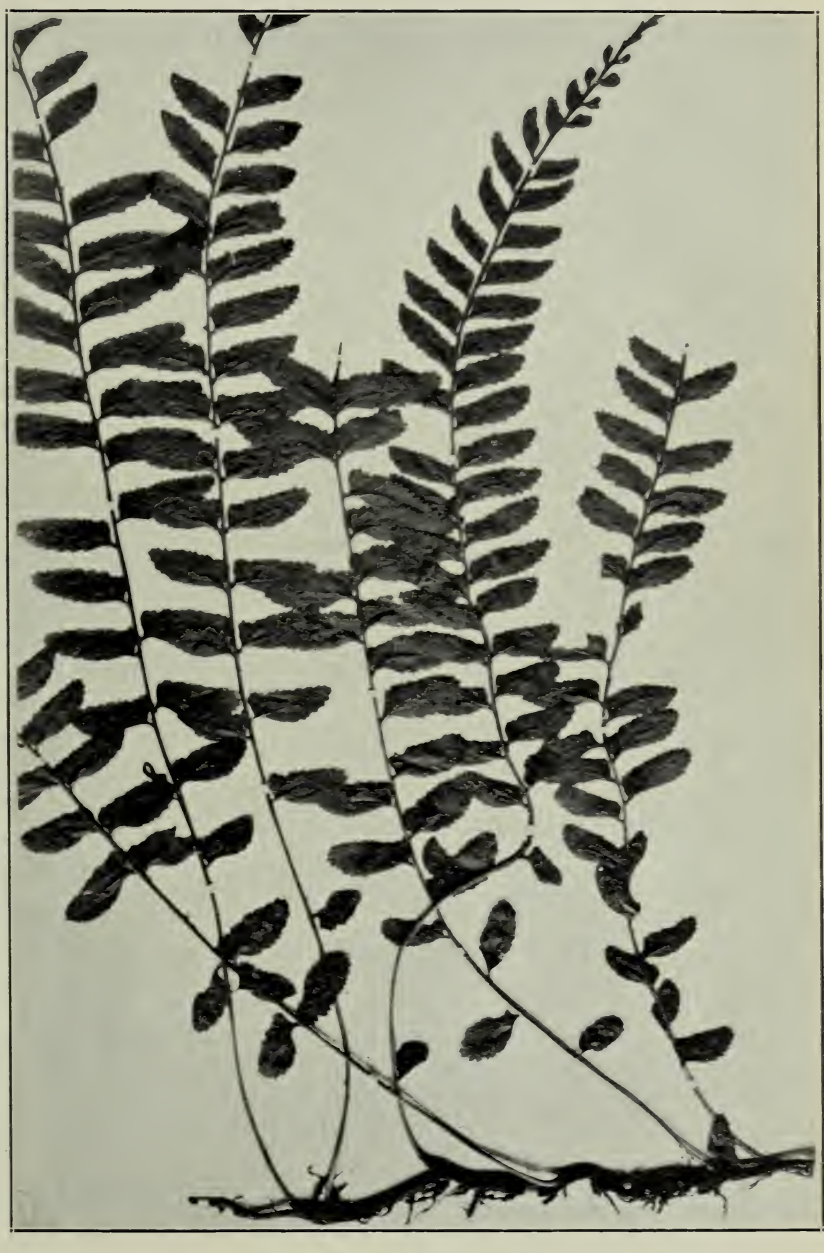
In monte Grahami prope Rockingham's Bay; J. Dallachy.

Caudex ad altitudinem 20′ scandens, angulosus, superne semi-pollicem crassus. Rachis frondis sterilis fere nuda. Pinnæ steriles 3–5″ longæ, 4–7‴ latæ; fertiles vix semilinea latiores. Sporangia flavida.

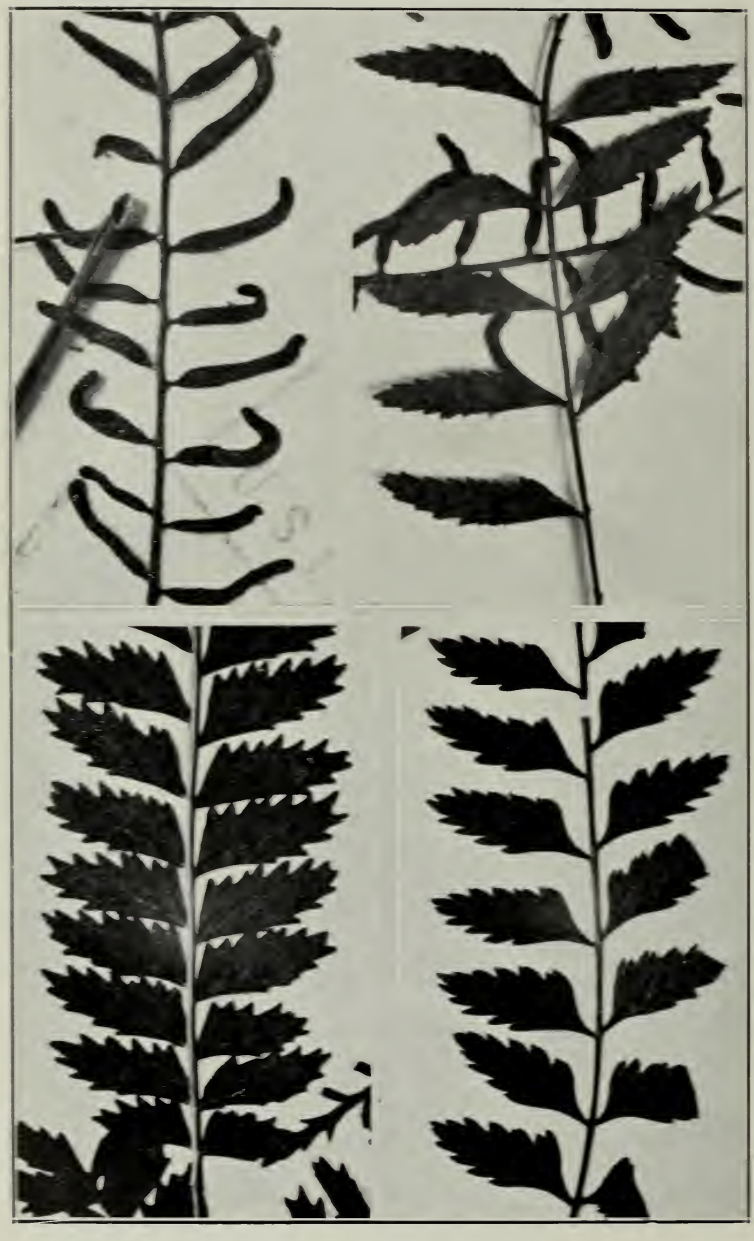
By the courtesy of Mr. C. T. White, I have examined a number of specimens from the Queensland Herbarium (Brisbane), and can add the following particulars to von Mueller's description.

Rhizome. The acrophyll-bearing rhizome may have at least four leaf-gaps. The bathyphyll-bearing rhizome has usually two leaf-gaps as in Eu-teratophyllum. One specimen shows a stout old rhizome bearing bathyphylls on young lateral branches; apparently this rhizome had fallen and was starting new growth again from its fallen position.

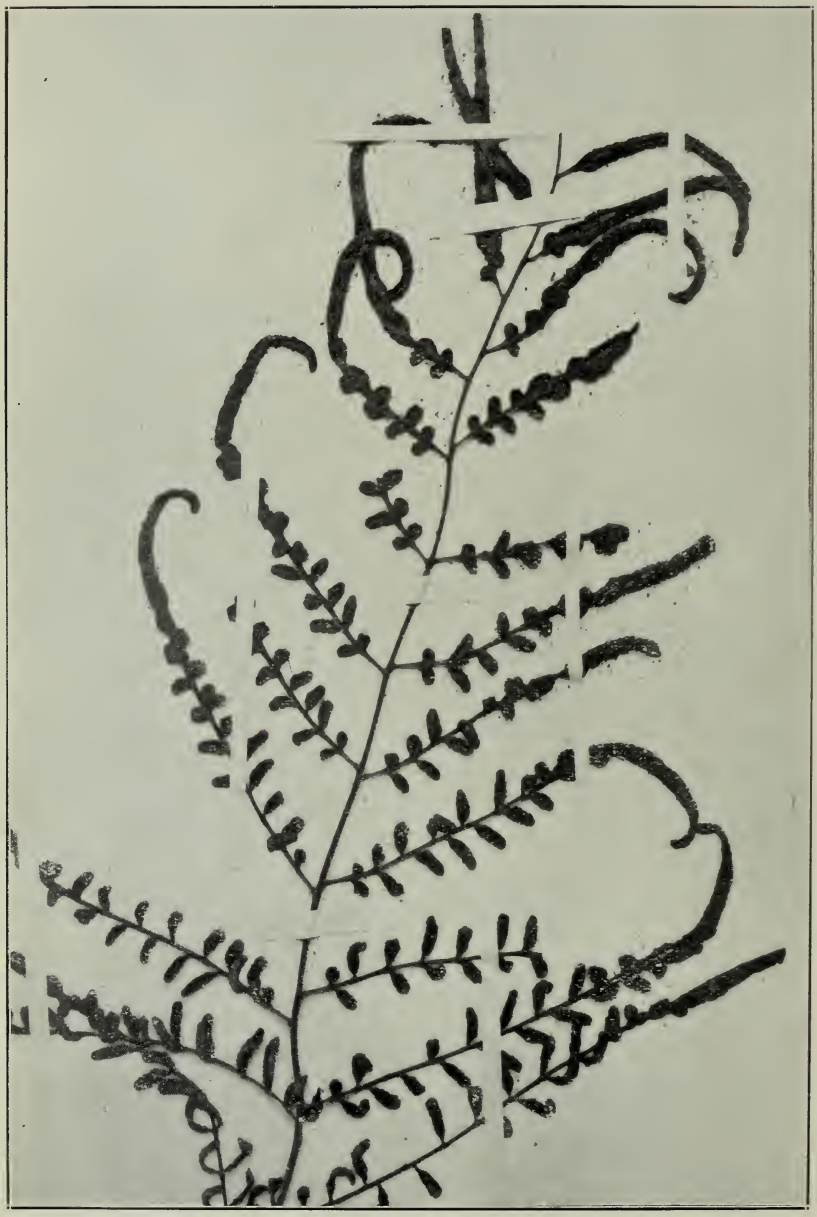
Bathyphylls. These are fully represented in the Brisbane collections. They vary a good deal in size, the largest approaching the smallest acrophylls in size of pinnæ. They differ constantly from the acrophylls in (1) the apex of the frond, which consists of a narrow toothed lamina, its midrib continuous with the rachis, and (2) the broadly truncate or even subauriculate upper base of the pinnæ. The smaller bathyphylls show a decided resemblance to the young stage of *T. articulatum* described above, or to pinnæ of acrophylls of *T. articulatum*.



Teratophyllum Brightiæ. Bathyphylls, ¾ nat. size. Eumundi, Shirley, U.S. National Herbarium.



Teratophyllum Wilkesianum. Above, Type specimen (fertile and sterile). Below, specimen from New Caledonia on left, from Tahiti on right (Setchell & Parks 294). All about x 1.5.



Teratophyllum Wilkesianum. Fertile frond showing condition intermediate between pinnate and bipinnate. Tahiti, Vesco, Manila Herbarium. $\frac{3}{4}$ nat. size.

The stipes vary in length, but are commonly 3 to 5 cm. long. The pinnæ are about 20 pairs, the lowest one or two usually unpaired. The middle pinnæ have winged stalks 1–2 mm. long, the upper base broadly truncate, the lower narrowly cuneate, the edge obliquely toothed, one vein-ending to each tooth, the apex rounded in the lower pinnæ, more or less acute in the upper ones, veins mostly forked (the lowest on the acroscopic side often twice forked); size of middle pinnæ of average bathyphylls about 2 cm. long by 5 mm wide. The rachis is winged almost throughout, the wing produced to a tooth below each pinna.

Sterile Acrophylls. All pinnæ are articulate; the pinna stalks 2–3 mm. long; the upper base sometimes very broadly cuneate, approaching the bathyphyll condition; the apex rather suddenly narrowed to a toothed subcaudate tip; the margins toothed very much as in simply pinnate specimens of *T. Wilkesianum* from New Caledonia and Samoa.

Fertile acrophylls. Pinna-stalks to 5 mm. long, pinnæ to 14 cm. long, usually not more than 1 mm. wide when dry; one specimen has pinnæ almost 2 mm. wide.

Distribution: Queensland, extending southwards just beyond the tropic.

Specimens examined. Eumundi, Bailey and Simmonds 1894 (several specimens, Br.), J. Shirley (W.). Palm Island, F. L. Bancroft (Br.). Herberton, F. M. Bailey (Br.). Between Herberton and Cairns, C. J. Wild 1891 (Br.). Range Trinity Bay, F. M. Bailey (Br.). Atherton Tableland, W. D. Francis, May 1928 (Br.). Scrub, Cairns District, Watts, July 1913 (Br.). Johnstone River, W. A. Kefford (Br.). Covering the branches of trees, below Bon Accord Falls, Blackall Range, C. T. White, Ap. 1918 (Br.).

Teratophyllum Wilkesianum (Brack.) Holttum comb. nov. **Plates 29, 30.**

Polybotrya Wilkesiana Brack. in Wilkes, U.S. Expl. Exped. 16: 80, pl. 10. 1884.

Lomagramma Wilkesiana Copel. Phil. Journ. Sci. 3C: 32. 1908. Maxon, Univ. Cal. Publ. Bot. 12: 28, pls. 3, 4. 1924.

The type of this species is in the U.S. National Herbarium, and has been kindly lent to me for inspection. It differs rather strikingly from all other specimens I have seen from Tahiti and from New Caledonia, so that it seems to me desirable to give a description first of the type only, and then to add some notes on the points in which other specimens differ. It is clear that Tahiti ferns which are referred to this species are very polymorphic, and more field study will be needed before we can understand them at all adequately. For the present I retain all under this species.

The chief characters of Wilkes' specimen are as follows.

Rhizome 1 cm. diameter, vascular cylinder with 8 leaf-gaps. *Stipe* 20 cm. long, stramineous, grooved on adaxial side, naked except for minute scattered dark narrow peltate scales. *Rachis* stramineous, when young scaly above with very narrow pale scales, naked when old, 2-grooved on the adaxial side, not winged but the outer margins of the grooves shortly papillate at the base of each pinna.

Pinnæ apparently about 12 pairs (rachis broken), all articulate to rachis, uppermost somewhat smaller than rest. *Sterile pinnæ* to at least 15 cm. long and 3.5 cm. wide, pinnate, lowest pinnules 8–15 mm. from main rachis; pinnules to about 18-jugate, about 7–9 mm. apart; pinna rachis distinctly winged, the wing broken and prolonged into an auricle at the base of each pinnule.

Sterile pinnules sessile or with a very short winged stalk, to 20 mm. long and 5 mm. wide, the base narrowly unequally cuneate, the apex falcate acute, the margins with oblique teeth about 1 mm. deep; veins 6–8 pairs, those on the acroscopic side all forked, on basiscopic side some at least simple, each vein ending close to the apex of a tooth; texture thin but firm; colour dark above, paler beneath; surfaces naked except for a few minute scales; the distal pinnules gradually reduced and adnate, merging into the apex of the pinna.

Fertile pinnules to about 18-jugate, distinctly stalked (stalks about 1 mm. long), 15–20 mm. long and hardly more than 1 mm. wide when dried, the base almost equally cuneate, the apex rounded. The venation of the fertile pinnules shows a very remarkable additional vascular supply to the sporangia, consisting of two rows of closed areoles, almost completely superseding the normal venation. There are indications of this in other fertile fronds, notably Franc 662 from New Caledonia, but in none that I have examined is the additional vascular system anything like so fully developed.

The other specimens differ from the type in the following points.

The *sterile pinnules* are usually a little shorter and wider, the upper base more broadly cuneate and the apex less falcate and less acute. The upper base is especially broad, almost truncate, in some specimens from New Caledonia, and in these the first vein is twice forked, approaching the condition found in *T. articulatum*. The marginal teeth are usually closer than in the type, but not appreciably deeper, except in some specimens which appear to be from young plants, or are perhaps bathyphylls; in these (both from Tahiti and New Caledonia, but especially the latter) the margins are deeply incised between the main lateral veins.

The *fertile pinnules* are always unequally cuneate at the base, sometimes pronouncedly so, and nearly all are shorter than the type, some barely 5 mm. long. The largest fertile pinnules I have seen on any specimen except the type are on Franc 662

from New Caledonia (specimen at Büitenzorg), on which they are as much as 15 mm. long.

Simply pinnate fronds occur on some specimens, from both Tahiti and New Caledonia (also Samoa), both sterile and fertile. Maxon, l. c., discusses these fronds and gives references to former literature. There can be no doubt that both bipinnate and pinnate fronds occur on the same plant. Setchell and Parks collected a frond showing an intermediate condition (their no. 512, figured by Maxon), and there is a specimen in the Manila herbarium (Vesco 1847) showing a similar intermediate condition in a fertile frond. It seems that the pinnate condition is sometimes but not always attained by plants of this species, and that the bipinnate condition is more usual. Setchell and Parks report the two as associated together. It is evident that the bipinnate fronds are not merely bathyphylls, as Setchell and Parks record them on a plant climbing high trees; and also there are bipinnate fertile fronds. It is probably significant however that there are no small pinnate fronds, and it is likely that this form is only developed on high climbing stems.

Pinnate sterile fronds. Pinnæ about 12-jugate, stalked, stalks of lower pinnæ to about 7 mm. long. Pinnæ of Setchell and Parks 512 to about 10 cm. long and 2 cm. wide, base unequally cuneate (broader in lower pinnæ than in upper), gradually narrowed from widest part just above base to near apex, apex rather suddenly narrowed to a linear portion about 1 cm. long, edges irregularly toothed, teeth short and not acute, one to each vein-ending, the margins slightly cartilaginous and reflexed; veins close, oblique, usually once forked. Pinnæ of simply pinnate fronds from Samoa and New Caledonia to 15 cm. long, the bases on the whole more broadly cuneate (especially in the upper pinnæ) and the edges rather more deeply toothed.

Pinnate fertile fronds. Pinna stalks to 7 mm. long; pinnæ to 10 cm. long and 5 mm. wide, base unequally cuneate, venation as in sterile pinnæ.

As above noted, the specimens from New Caledonia differ in some points from Tahiti specimens, but I do not think that the differences are clear enough to warrant the description of a new species. It is very remarkable that though specimens have been collected in Samoa, none have been reported from Fiji, which is nearer to New Caledonia. The Samoa specimens appear to be nearer to those of New Caledonia than to those of Fiji.

TAHITI. U.S. South Pacific Exploring Exp., Wilkes (Type, W.). Setchell and Parks 211 (W.), 294 (W.), 296 (B., S., W.), 315 (W.), 512 (W.). Grant 4459 (B., W.). M. Vesco s.n. 1847, dist. Paris (M.). N. J. Andersson s.n. 1852, dist. Stockholm (W.).

NEW CALEDONIA. Franc 662, herb. Bonati (B., W.). Rosenst. Fil. Nov. Cal. exsic. 16, leg. Franc (M., W.) and 113,

leg. Franc (W.). Cribs s.n. 1901, dist. Paris (M.). Richards s.n. 1863, dist. Sydney (W.).

SAMOA. West Savaii, Reinecke 87*b* (B., W.).

Doubtful Species

Lomariopsis Balansæ Fourn. Ann. Sci. Nat. V. 18: 271. 1873.

This is described as a simply pinnate species, and there is nothing in the original description which gives any definite information as to which of the genera Lomariopsis or Teratophyllum is concerned. There is however a specimen at Kew (Franc 663, Herb. Bonati) which was determined by Christ as *L. Balansæ;* this is very close to *Teratophyllum Wilkesianum,* and apart from shorter stalks of the pinnæ I could not see any definite distinction. The spores have a finely granular perispore. In the absence of further information this must be regarded as a doubtful species. Examination of the type to see whether or not the terminal pinna is articulated would at least decide the genus.

Discussion on the Polyseriatæ

As indicated in the diagnosis, the species of this section of the genus agree together in having the fronds on the climbing rhizome polyseriate, not biseriate as in Euteratophyllum. It is probable also that they have certain distinctive points in common as regards their bathyphylls, but the information at present available is incomplete. There appear to be no other constant features in which all of them differ from Euteratophyllum. The bipinnate acrophylls of *T. articulatum* and *T. Wilkesianum* are certainly different from anything in Euteratophyllum, but the simply pinnate acrophylls of *T. Wilkesianum* and *T. Brightiæ,* if parted from their rhizome, could not be distinguished from Euteratophyllum. *T. Brightiæ,* with its complete lack of all bipinnate fronds, is closely similar to Euteratophyllum except in its bathyphylls.

The bathyphylls of *T. Brightiæ* (and probably also those of *T. articulatum,* judging from a very young stage) differ from those of all species of Euteratophyllum in having distinct stipes free of pinnæ; all Euteratophylla have the lowest bathyphyll pinna right against the rhizome and reflexed to overlap the rhizome. Most Euteratophylla also have much more deeply dissected bathyphyll pinnæ, though a few are simply pinnate.

As regards the general question of the relationship of Teratophyllum to other fern genera, I cannot give any opinion beyond the suggestions made in my former paper. It seems probable that Teratophyllum and Lomariopsis are closely related, but Teratophyllum is a much more specialised genus in many ways, with a more restricted distribution. I think that they have probably had independent origins in a group of acrostichoid ferns with short-creeping rhizomes; possibly from Bolbitis.

THE GARDENS' BULLETIN STRAITS SETTLEMENTS

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